VOLVO

Service Manual

Reconditioning

Section 2 (21)

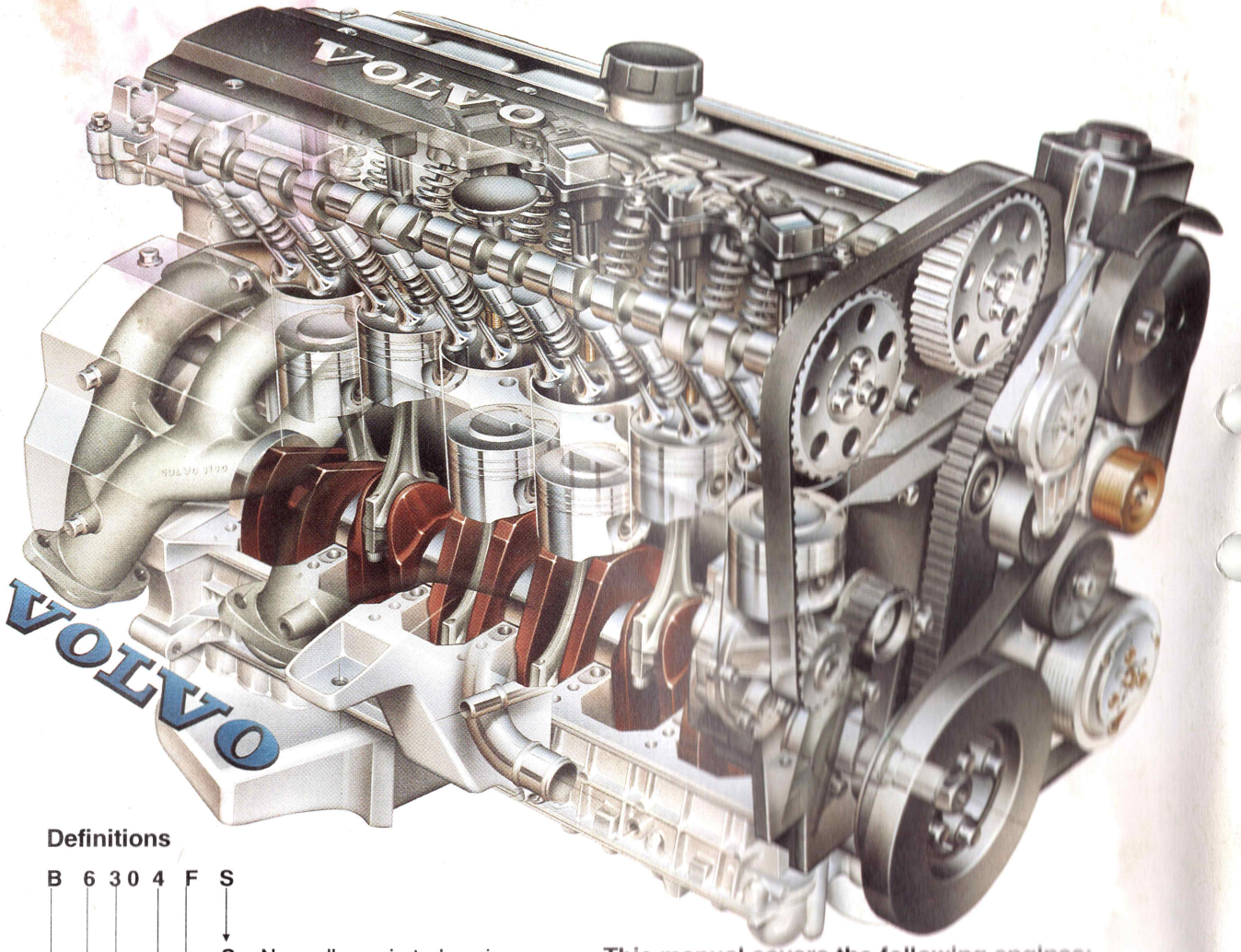
Engines B 6244,
B 6254,
B 6304

960 1991-

TP 2103031

Volvo Car Corporation

B 6244, B 6254, B6304



Definitions

B 6 3 0 4 F S

- **S** = Normally aspirated engine
- **F** = Injection engine with catalyzer
- **G** = Injection engine without catalyzer
- **4** = Valves per cylinder
- **3 0** = Cylinder capacity
- **6** = No. of cylinders
- **B** = Petrol

This manual covers the following engines:

Engine model	Year
B 6244	1995–
B 6254	1995–
B 6304	1991–

Modifications to March 1994 included

Modifications introduced after the above date are not covered in this manual. See Service Bulletins as applicable.

Volvos are sold in versions adapted for different markets. These adaptations depend on many factors including legal, taxation and market requirements. This manual may therefore show illustrations and text which do not apply to cars in your country.
Volvo owners planning to export their car(s) to another country should investigate the applicable safety and exhaust emission requirements. In some cases it may be impossible to comply with these requirements.

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Reconditioning engine

Dismantling engine, cleaning, inspection

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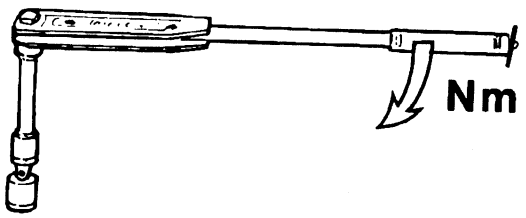
This service manual covers engine reconditioning only. For work on engine in car and lifting engine in and out, see separate service manual: **Section 2 (20-22, 25-26)**.

Order reference: TP 2103201 (USA/CDN)
TP 2103031 (UK)
Replaces manual: TP 31804/1

We reserve the right to make alterations without prior notification.

Important



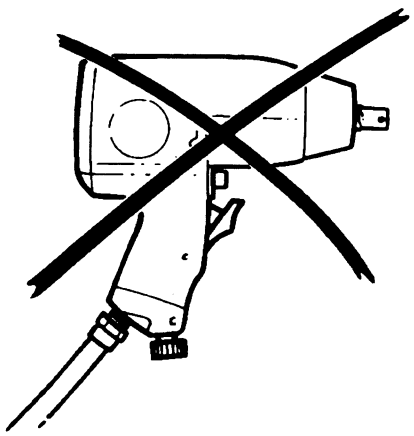
S135 020

Torque settings

The torque settings in this manual are shown in two ways:

1. Torque settings in **bold type** (e.g. 'Tighten to **40 Nm**') are used (in **bold**) for components which must be tightened with a torque wrench (plus any angle setting).

2. Torque settings in ordinary type ('Torque setting = 40 Nm') are guidelines only; there is no need to use a torque wrench.

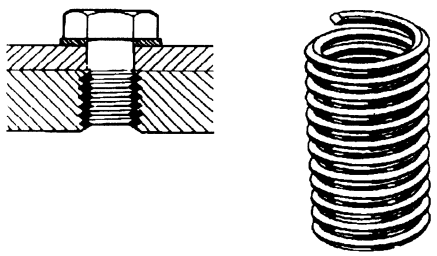


S151 092

Power screwdrivers

Power screwdrivers must not be used on screw joints with aluminium threads.

There is a major risk of damaging the threads and the component itself.



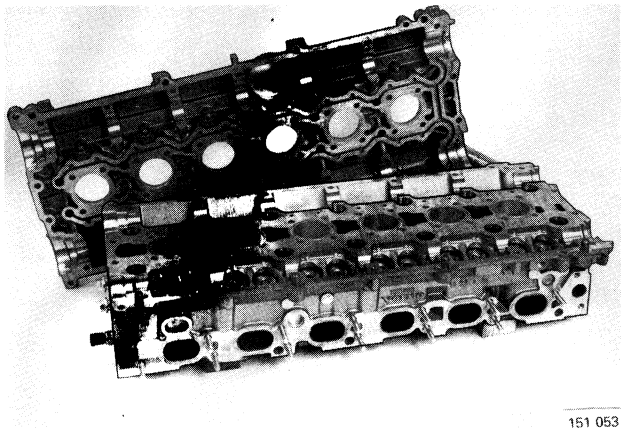
S147 453

Threads, repair

In most cases, threads can be repaired using thread inserts.

Important: If conical threads are damaged, replace component.

Thread repairs, see 'Thread repairs' on page 41 of this manual.



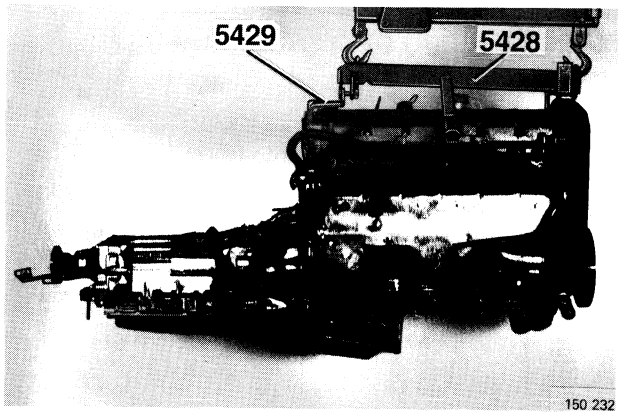
151 053

Liquid sealing compound

Engines use liquid sealing compound (P/N 1 161 059-9), e.g. between the upper and lower halves of the cylinder head.

It is essential that the surfaces are thoroughly cleaned and all traces of oil removed before applying new compound.

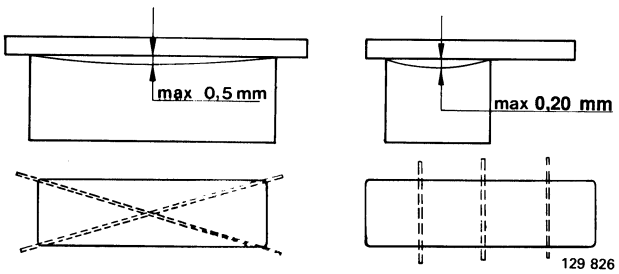
Apply compound with a short-haired roller (951 1205), covering completely but without any overflow.



150 232

Suspended engine

Warning: Before carrying out work on a suspended engine, ensure that the lifting equipment is **securely attached** and is in **perfect condition**, and check lifting lugs for cracks, loose bolts, etc.

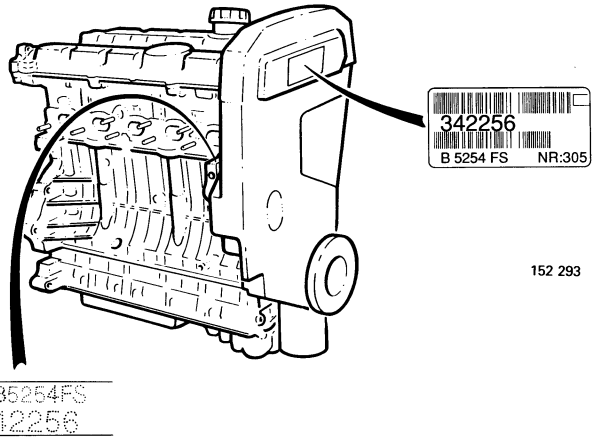


129 826

Cylinder head, machining

Important: Machining to remove scoring or corrosion marks on cylinder head joint face must only be carried out if the head is undistorted.

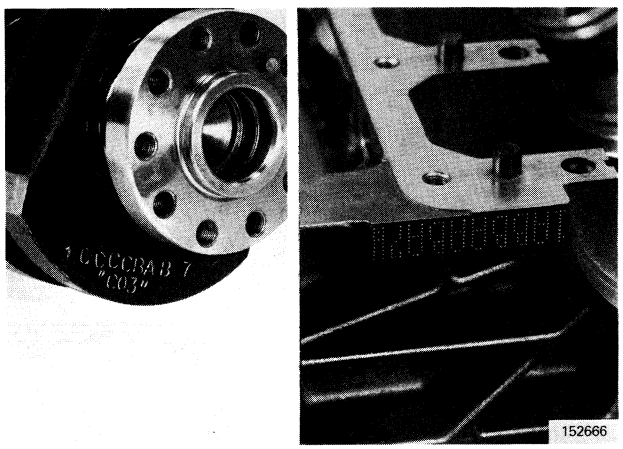
Specifications



Engine serial and type numbers

The engine serial and type numbers are punched in on the right-hand side of the cylinder block.

There is also a decal on the timing cover, showing the engine type, serial and works number.

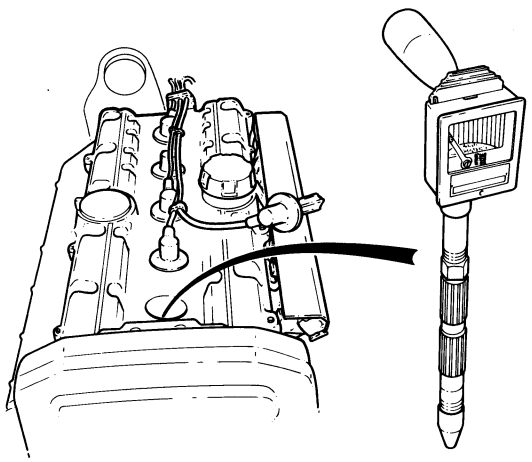


Classification of crankshaft main bearings

This information is punched into the cylinder block and crankshaft.

Block classification

Crankshaft classification	A small diameter		B medium diameter		C large diameter	
	block	int sect	block	int sect	block	int. sect.
A small	yellow medium	yellow medium	yellow medium	blue thick	blue thick	blue thick
B medium	red thin	yellow medium	yellow medium	yellow medium	yellow medium	blue thick
C large	red thin	red thin	red thin	yellow medium	yellow medium	yellow medium



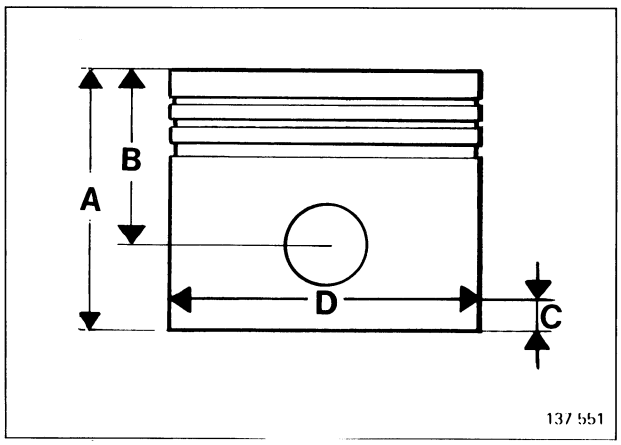
Compression

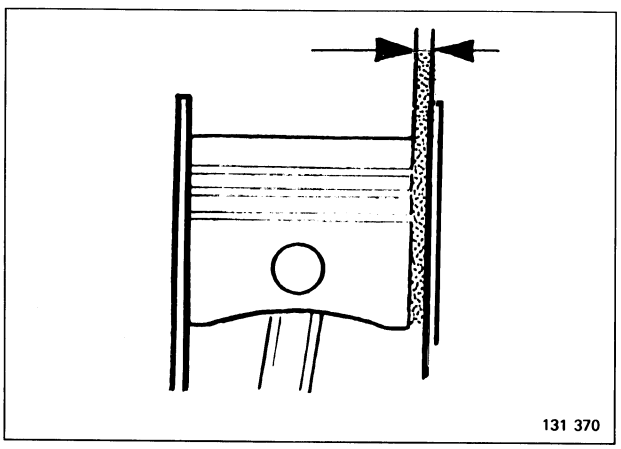
Normal value ..... **MPa 1.0-1.5**

Note: Applies with engine warm and throttle wide open, turning starter motor at 4.2 r/s (250-300 r/min).

Other general data

	B 6244	B 6254	B6304
No. of cylinders	6	6	6
Cylinder diameter . . . . . mm	81.0	81.0	83.0
Stroke . . . . . mm	77.0	80.0	90.0
Capacity . . . . . dm^3 (l.)	2.381	2.473	2.922
Firing order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Compression pressure . . . . . MPa(psi)	1.3–1.5(184-213)	1.3–1.5(184-213)	1.3–1.5(184-213)
Max. difference between max./min. values . . . . . MPa(psi)	0.2(28)	0.2(28)	0.2(28)
Weight, complete (including auxiliaries and oil) . . kg	approx.: 180	approx.: 180	approx.: 180





Pistons

Engine type	Dimensions in mm		
	A	B	C
B 6244	66.4	42.4	16.0
B 6254	68.8	40.9	16.0
B 6304	59.9	35.9	16.0

Piston diameter: (D)

Standard		**B6244/B6254**	**B6304**
Piston marked C	mm	80.98–80.99	82.98–82.99
Piston marked D	mm	80.99–81.00	82.99–83.00
Piston marked E	mm	81.00–81.01	83.00–83.01
Piston marked G	mm	81.017–81.032	83.017–83.032

Oversize		**B6244/B6254**	**B6304**
Oversize 1	mm	81.177–81.192	83.177–83.192
Oversize 2	mm	81.377–81,392	83.377–83.392

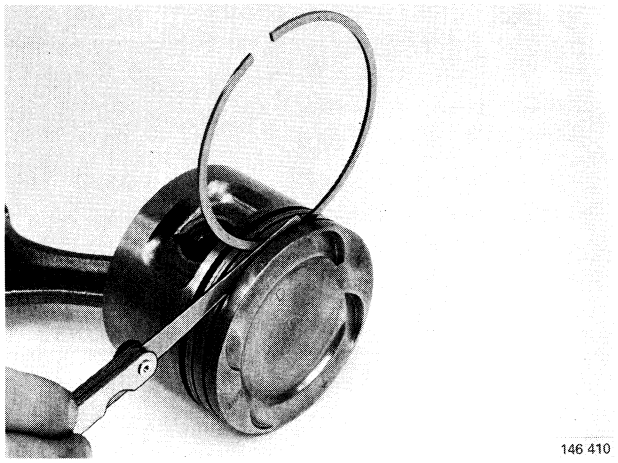
Max. difference in weight between pistons in same engine: **10 g.**

Piston clearance

		Minimum	Maximum
Measured cylinder diameter:	mm	96.02	96.03
Measured piston diameter	mm	-96.01	-96.00
Piston clearance	mm	0.01(min)	0.03 (max)

Piston clearance should be:

B 6244, B6254, B6304 . . . . . mm 0.01–0.03



146 410

Piston rings

Piston rings, side clearance

Upper compression ring ..... **mm 0.05–0.085**

Lower compression ring ..... **mm 0.03–0.065**

Oil scraper ring ..... **mm 0.02– 0.055**

Dimensions, version 1

Upper compression ring .....**mm 1.5**

Lower compression ring .....**mm 1.75**

Oil scraper ring .....**mm 3.0**

Dimensions, version 2 (1994-)

Upper compression ring .....**mm 1.2**

Lower compression ring .....**mm 1.75**

Oil scraper ring .....**mm 3.0**

Gudgeon pin, diameter .....**mm** $23.0^{+0}_{-0.004}$

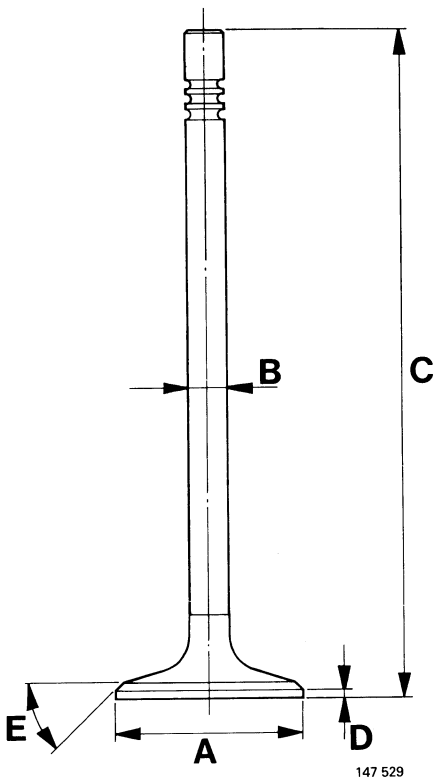
Note: Later versions of the Volvo 960 have two piston designs, with differences in the upper compression ring. Version 1 can be replaced with version 2 without replacing all pistons, but version 2 must **not** be replaced with version 1.

Piston weight

B6244 ..... **g 375**±5

B6254 ..... **g 380**±5

B6304 ..... **g 360**±5



147 529

Valves

A. Valve head diameter

Intake ..... **mm 31.00**±0.15

Exhaust ..... **mm 27.00**±0.15

B. Valve stem diameter

Intake ..... **mm** $6.97^{+0}_{-0.015}$

Exhaust ..... **mm** $6.97^{+0}_{-0.015}$

C. Overall length

Intake ..... **mm 104.05**±0.18

Exhaust ..... **mm 103.30**±0.18

Max. machining allowance, valve stem ..... **mm 0.4**

D. Valve head height

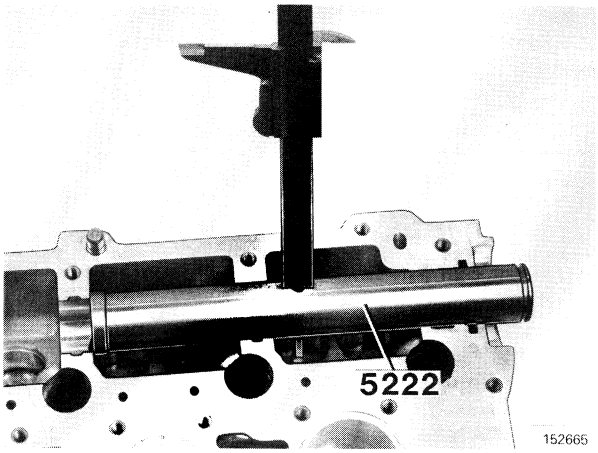
Intake/exhaust ..... **mm 1.5**

Min. height after grinding ..... **mm 1.2**

E. Sealing face angle

Intake ..... **44.5°**

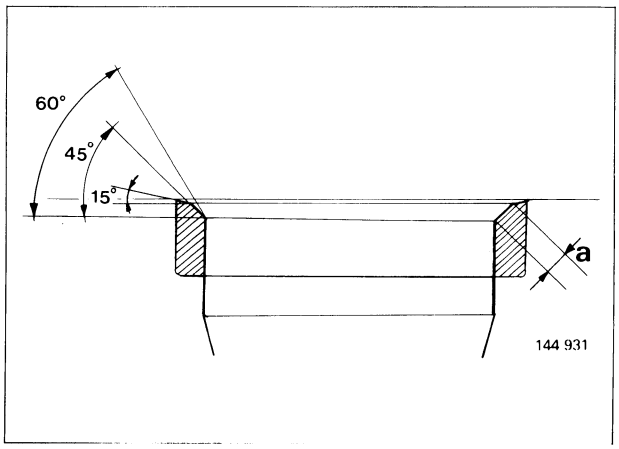
Exhaust ..... **44.5°**



Valve stem height

Valve stem height ..... **mm 48.5±0.4**

Max. machining allowance ..... **mm 0.4**



Valve seats, angles and width (reconditioned)

Angles:

Sealing face angle, intake/exhaust: ..... **45°**

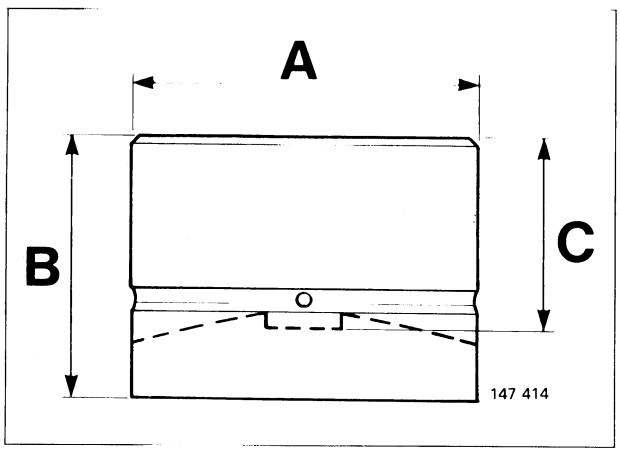
Relief angle, upper: ..... **15°**

Relief angle, lower: ..... **60°**

Valve seat width:

Intake: ..... **mm 1.4–1.8**

Exhaust: ..... **mm 1.8–2.2**



Tappets, dimensions

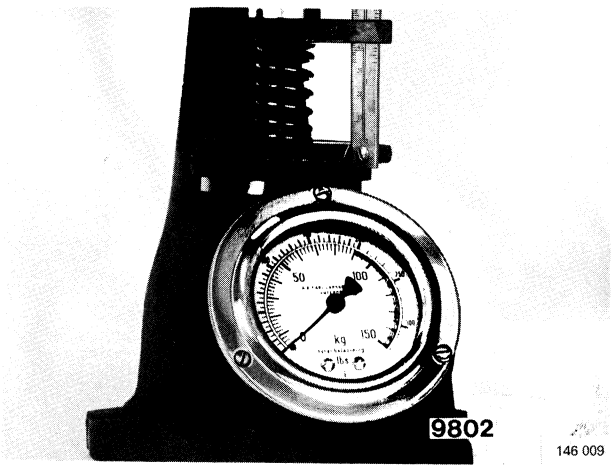
A External diameter: ..... **mm $32^{+0.025}_{-0.041}$**

B External height: ..... **mm 26±0.5**

Distance between top of tappet and piston

C(1) Unloaded: ..... **mm 18.40**

C(2) Compressed: ..... **mm $16.15^{+0.3}_{-0.1}$**

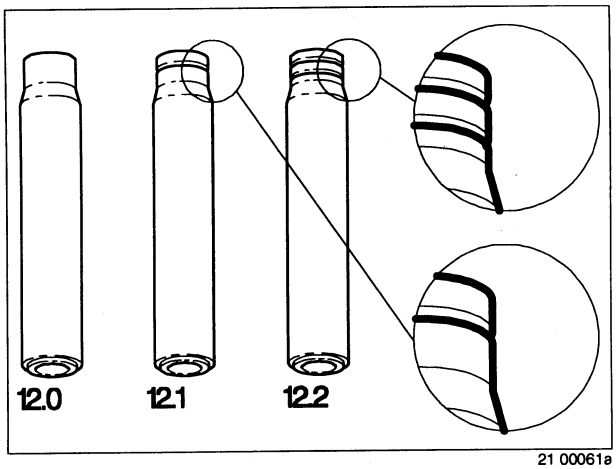


Valve springs, dimensions

External diameter: ..... **mm 26.20**

Internal diameter: ..... **mm 18.10**

Length (mm)	**Load (N)**(lb)
L: 43.0	0 (0)
L1: 34.0	270±15 (61±3.4)
L2: 24.5	670±32 (151±7)



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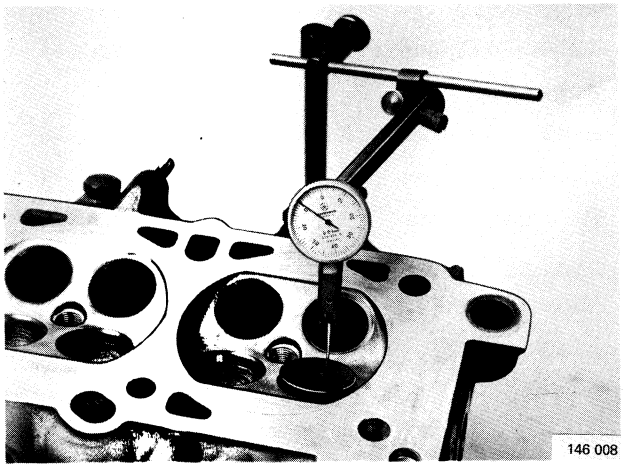
Valve guides, markings and dimensions

Dimension type	Diameter mm	No. of grooves	P/N
Standard	12.0	0	9135628-7
Oversize, no. 1	12.1	1	9135630-3
Oversize, no. 2	12.2	2	9135631-1


146 008

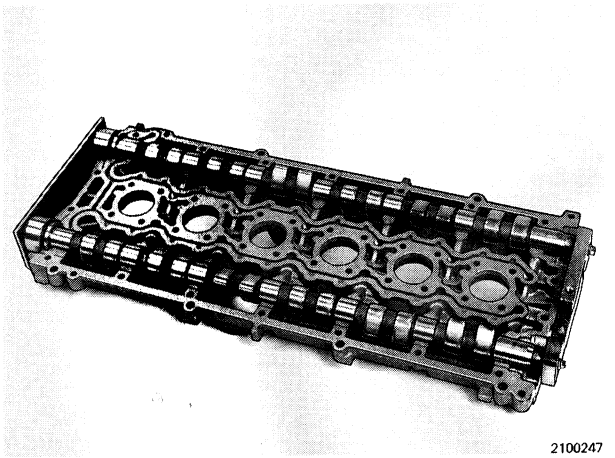
Clearance between new components:

Intake: ..... **mm 0.03–0.06**

Exhaust: ..... **mm 0.04–0.07**

Max. clearance, used components:

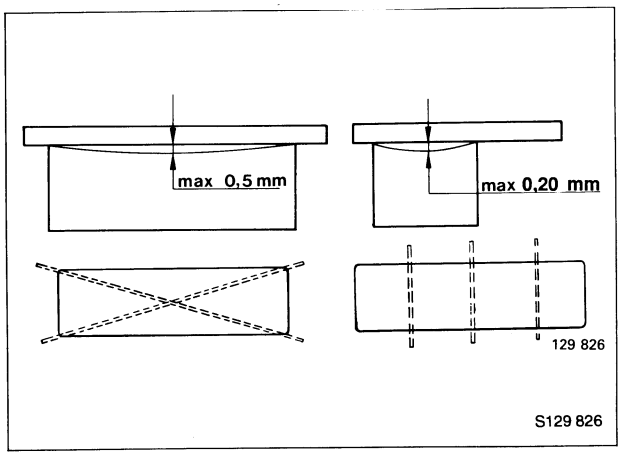
Intake/exhaust: ..... **mm 0.15**


2100247

Camshafts

Engine type	Camshaft			
	Markings		Max. lift	
	Intake	Exhaust	Intake	Exhaust
B6244/B6254*	PMI	PHE	7.95	7.95
B6304	PCI	PCE	9.00	9.00

* Also applies to B 6304 FS2 (USA) with air pump.



S129 826

Cylinder head

Max. distortion:

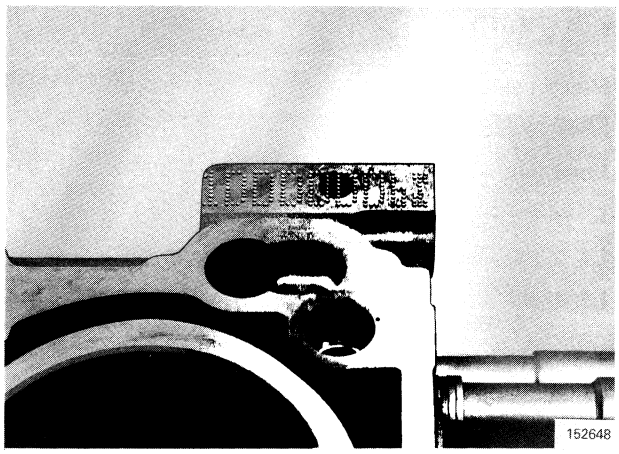
Longitudinal: ..... **mm 0.50**

Lateral: ..... **mm 0.20**

Cylinder head height: ..... **mm 129.0**±0.05

Max. machining allowance: ..... **mm 0.30**

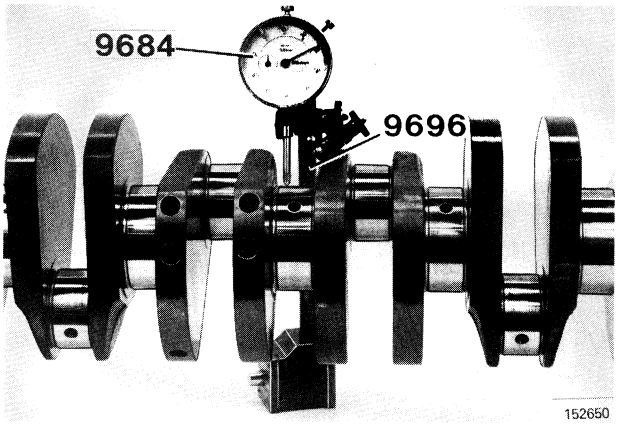
Important: Machining of the cylinder head to remove scores or corrosion marks on the joint face must only be carried out if the head is undistorted.


152648

Cylinder bore diameter

Standard		**B6244/B6254**	**B6304**
Bore marked C	**mm**	81.00–81.01	83.00–83.01
Bore marked D	**mm**	81.01–81.02	83.01–83.02
Bore marked E	**mm**	81.02–81.03	83.02–83.03
Bore marked G	**mm**	81.04–81.05	83.04–83.05
Oversize			
Oversize 1	**mm**	81.20–81.21	83.20–83.21
Oversize 2	**mm**	81.40–81.41	83.40–83.41

Cylinders should be rebored when wear reaches 0.10 mm.



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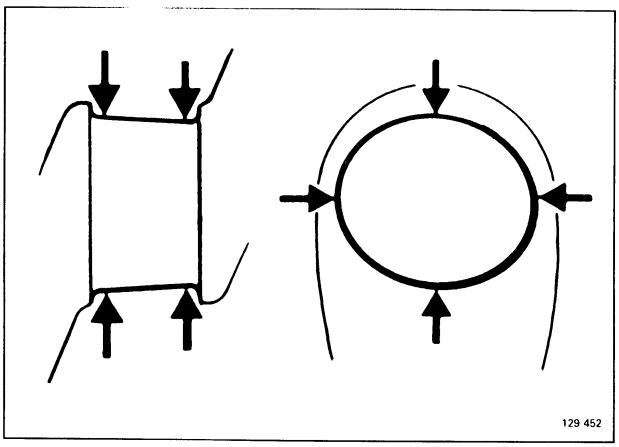
Crankshaft

Max. throw ..... **mm 0.040**

Max. axial clearance ..... **mm 0.19**

Main bearings, radial clearance ..... **mm 0.019–0.043**


129 452

Crank pins

Diameter, standard ..... **mm 50.000**
undersize ..... **mm 49.750**

Bearing seat width ..... **mm 26.000**

Max. out-of-round ..... **mm 0.004**

Max. taper ..... **mm 0.004**

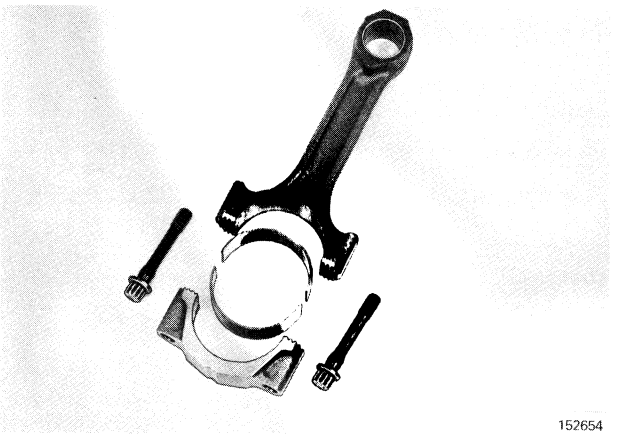
Main bearing journals

Diameter, standard ..... **mm 65.000**
undersize ..... **mm 64.750**

Axial bearing seat width ..... **mm 26.00**

Max. out-of-round ..... **mm 0.004**

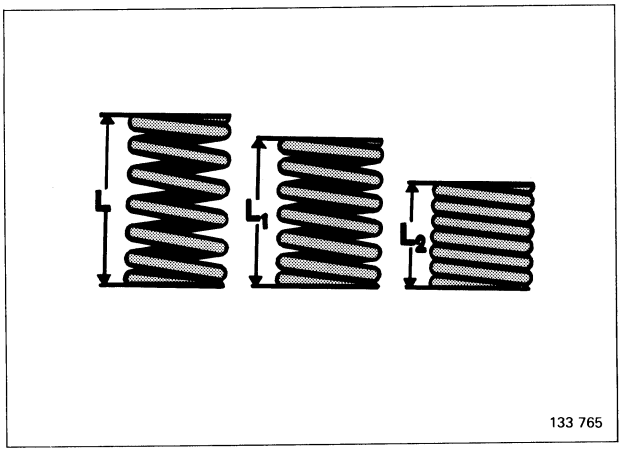
Max. taper ..... **mm 0.004**


152654

Connecting rods

Bearing seat diameter,
big end ..... **mm 53.0**

Max. out-of-round ..... **mm 0.006**



133 765

Oil pump

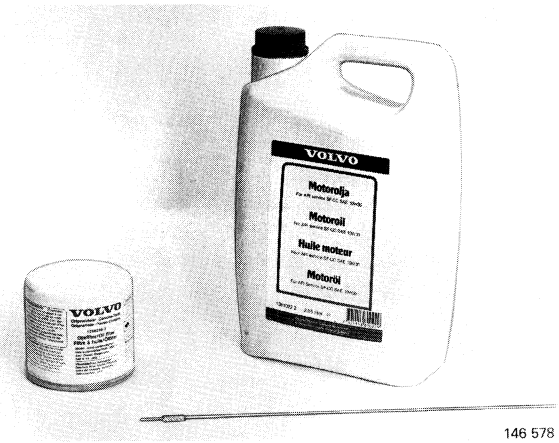
Relief valve springs

(*P/N 1397819*)

Load (N)	Length (mm)
L: 0	76.22
L1: 52±4	56.10
L2: 85±8	39.90

(P/N 9135202)

L: 0	76.22
L1: 59±4	56.10
L2: 108± 8	39.90



146 578

Engine oil

Refilling after reconditioning

Capacity, incl. oil filter

B6244, B6254, B6304 ..... **7.00 liter** (7.42 US qt)

Oil grade

As per API-Service ..... min. SG*

As per CCMC ..... class G4/G5

*Oils designated SG/CD meet these requirements.

Oil pressure (min)*

12.5 r/s (750 r/min) ..... **MPa 0.10** (14.5 psi)

67.7 r/s (4000 r/min) ..... **MPa 0.35** (49 psi)

Max. oil pressure
(relief valve opening): ..... **MPa 0.70** (99 psi)

(1 kp/cm^2 ≈ 0.10 MPa)

*Specified oil pressure applies with oil temperature at 100°C, which is reached after 10-15 minutes' running.

150 353

Thermostat

Markings **87**

Starts opening at ..... **87°C (187°F)**

Fully open at ..... **102°C (216°F)**

Markings **90**

Starts opening at ..... **90°C (194°F)**

Fully open at ..... **105°C (221°F)**

Torque settings

Torque settings apply with nuts and bolts oiled. Degreased (cleaned) components must be oiled before assembly.

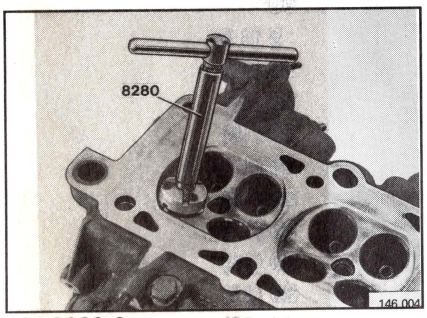
Components	Nm/ (ft. lb)degrees Nm/degrees
Exhaust manifold, at cylinder head	24
Exhaust manifold, heat shield	15
Cylinder head, stage 1	20
stage 2	60
stage 3 (angle tightening)	130°
Cylinder block, intermediate section, stage 1 (M10)	20
stage 2 (M10)	45
stage 3 (M8)	25
stage 4 (M7)	17
stage 5 (M10) (angle tightening)	90°
RPM sensor	5
Intake manifold	17
Camshaft carrier cover	17
Camshaft pulleys	20
Timing belt, tensioner pulley	24
Timing belt, tensioner mounting	24
Timing belt, idler pulley	(91-93) 39, (94-) 30
Knock sensor	20
Coolant pump	20
Carrier plate, stage 1	45
stage 2 (angle tightening)	50°
Torque arm, stage 1	50
stage 2 (angle tightening)	90°
Torque converter	30
Flame trap	15
Oil sump plug	35
Oil pump	10
Oil sump	17
Oil pressure sensor	25
Flywheel, stage 1	45
stage 2 (angle tightening)	65°
Vibration damper, center nut	300
Vibration damper, flange bolt, stage 1	35
stage 2 (angle tightening)	60°
Sparkplugs (do not oil)	25
Conrod bearing caps, stage 1	20
stage 2 (angle tightening)	90°
Gearbox, to engine	50

Universal tools

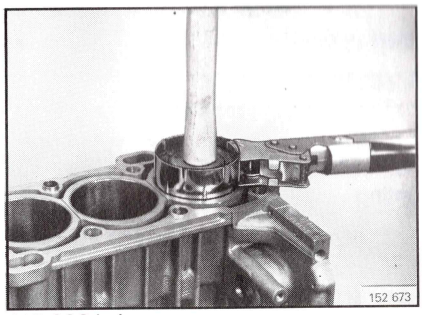
115	Description - use
8280-6	**Milling tool,** milling valve seats
8281-4	**Piston ring compressor,** installing pistons in block

951	Description - use
2015-5	**Clamp,** used in conjunction with 998 6052
1205-8	**Roller,** for applying liquid gasket

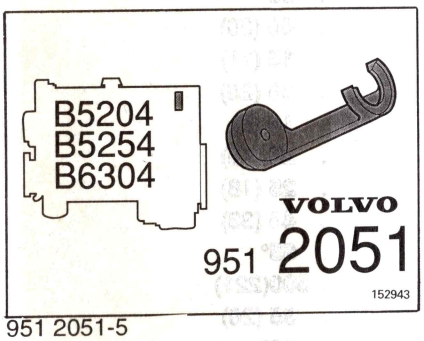
998	Description - use
5424-2	**Piston ring compressor,** installing piston rings in block
6052-0	**Valve clamp,** removing/installing valve collets
8500-6	**Belt tension gauge,** checking timing belt tension



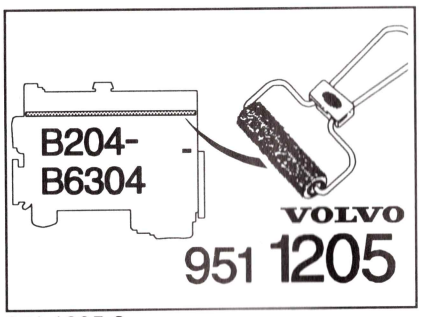
115 8280-6



115 8281-4

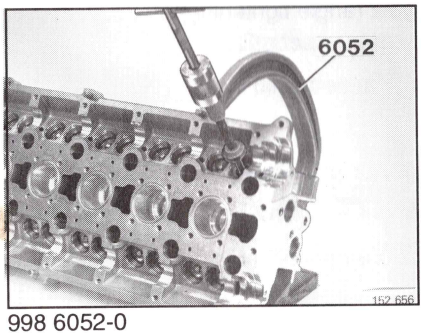


951 2051-5

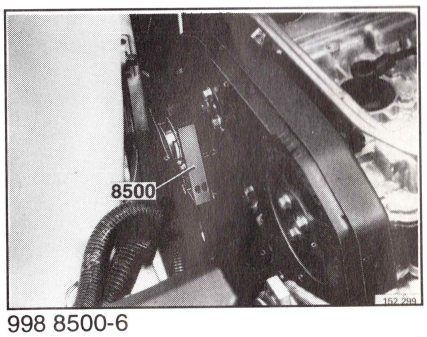


951 1205-8 080046

998 5424-2



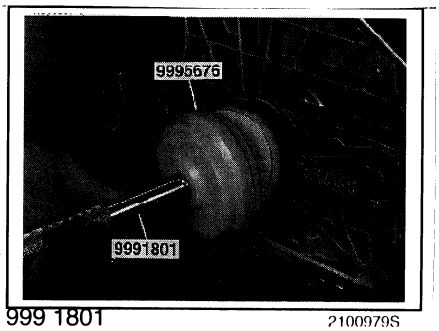
998 6052-0



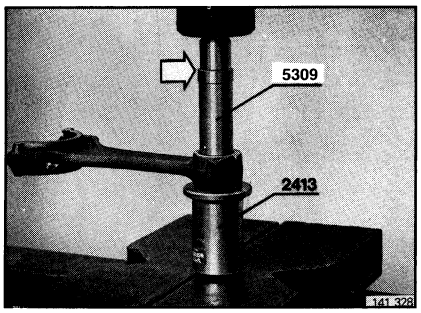
998 8500-6

Special tools

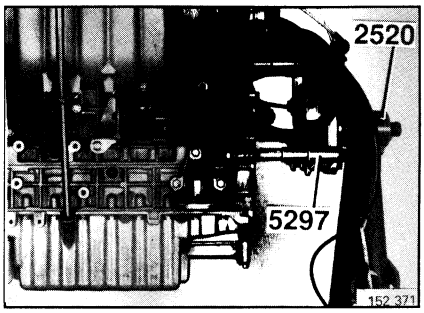
999	Description - use
1801-3	**Standard handle,** for attachment to drifts
2413-6	**Counterhold,** replacing conrod bushings
2520-8	**Stand,** for fixtures
2810-3	**Lifting yoke,** removing/installing engine
5199-8	**Counterhold,** removing/installing camshaft pulleys
5112-1	**Gear segment,** locking flywheel
5219-4	**Valve guide retainer,** removing/installing valve guide seals
5222-8	**Gauge,** measuring valve stem length
5297-0	**Fixture,** mounting engine in stand 2520



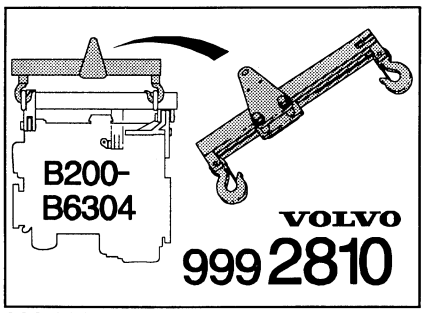
999 1801 2100979S



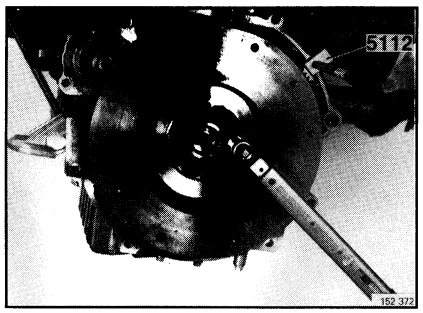
999 2413-6



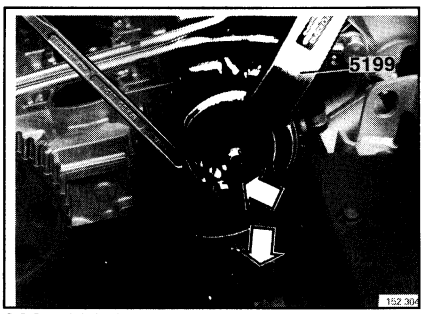
999 2520-8



999 2810-3 08 00431



999 5112-1



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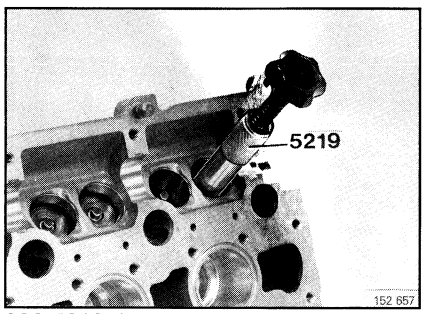

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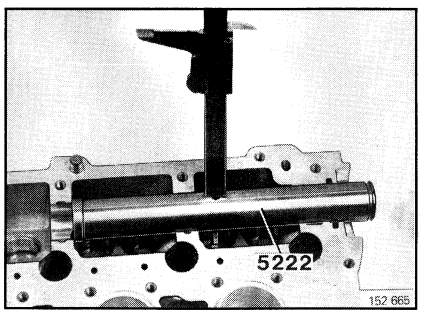
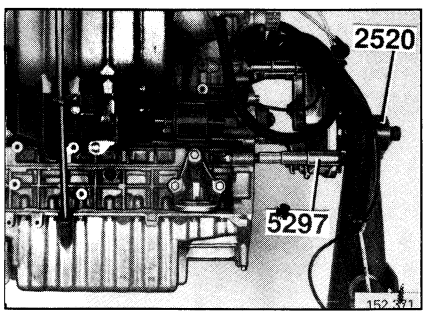
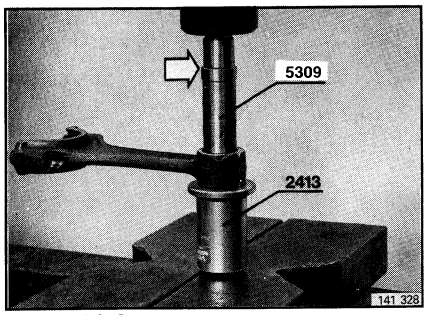


999 5222-8

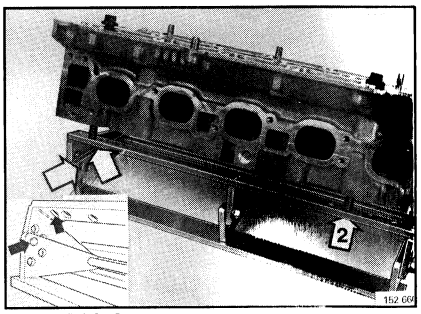


999 5297-0

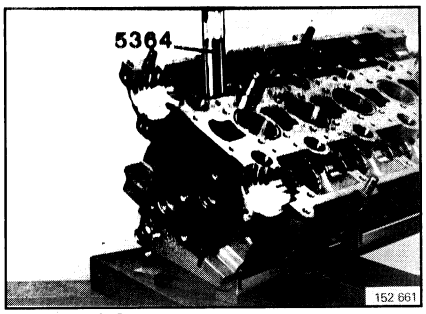
999	Name - application
5309-3	**Drift,** replacing connecting rod bearing
5363-0	**Fixture,** removing/installing cylinder head, valve guide
5364-8	**Drift,** removing/installing valve guides
5365-5	**Drift,** removing/installing valve guides
5505-6	**Drift,** installing valve guides
5367-1	**Reamer,** inner valve guide
5373-9	**Reamer,** cylinder head oversized valve guide
5379-6	**Drift,** installing valve stem seal
5428-1	**Lifting yoke,** engine



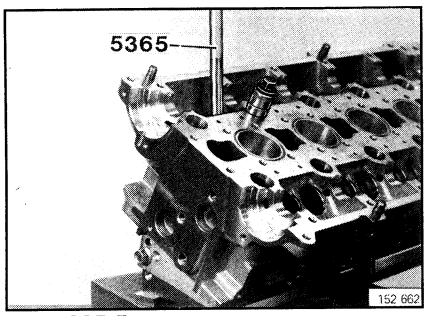
999 5309-3



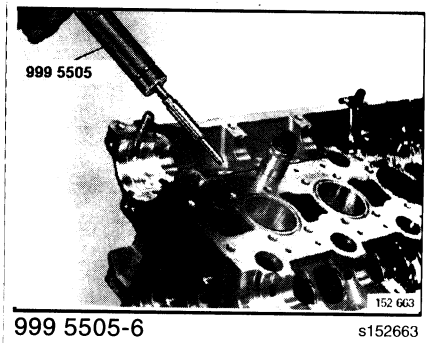
999 5363-0



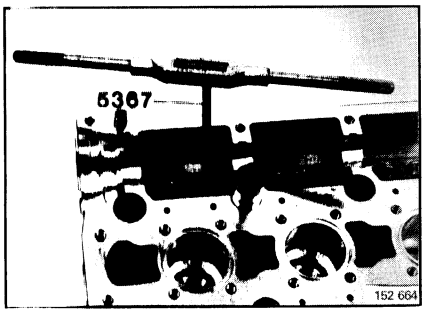
999 5364-8



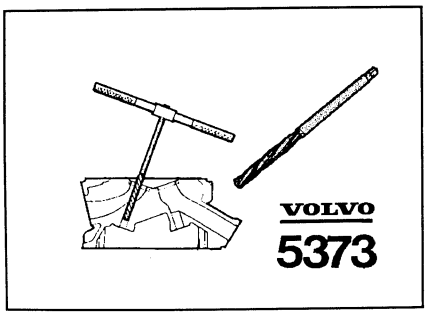
999 5365-5



999 5505-6 s152663



999 5367-1



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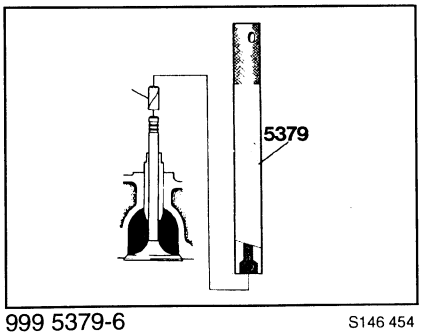

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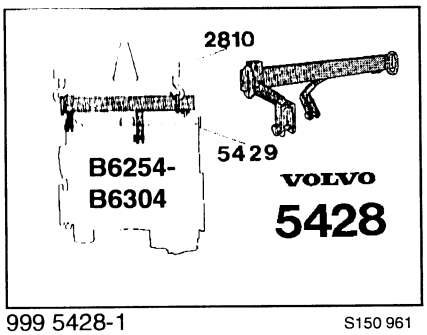
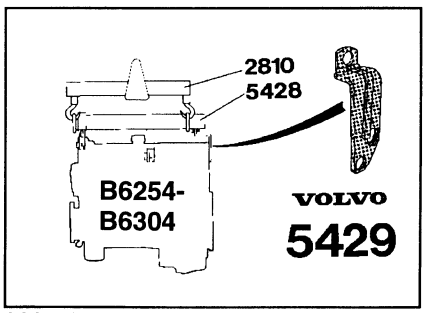
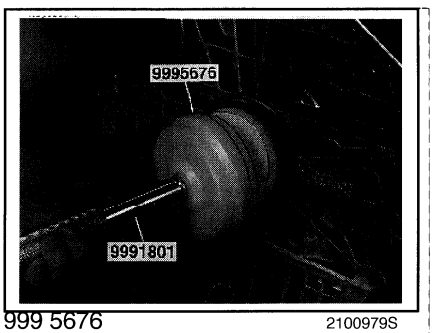


999 5428-1 S150 961

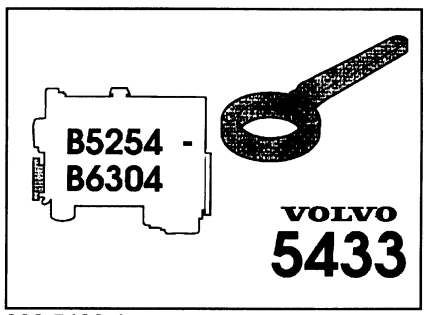
999	Name - application
5429-9	**Lifting eyelet,** (B 6304) engine
5433-1	**Counterhold,** removing/installing vibration damper
5449-7	**Drift,** installing front camshaft seal
5450-5	**Drift,** installing rear camshaft seal, 4-valves (for 2-valves, see tool 5509)
5451-3	**Camshaft adjustment tool,** installing crankshaft
5452-1	**Camshaft adjustment tool,** installing camshafts
5453-9	**Holder,** front camshafts, 4-valves (for 2-valves, see tool 5508)
5454-7	**Press tool,** installing camshafts
5676-5	**Drift,** installing rear seal



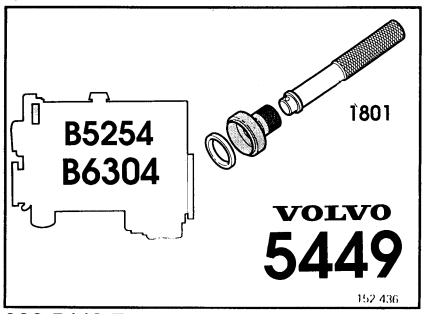
999 5429-9 S150 962



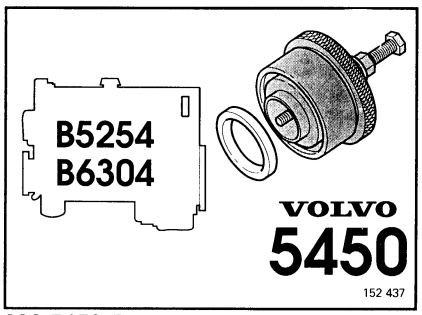
999 5676 2100979S



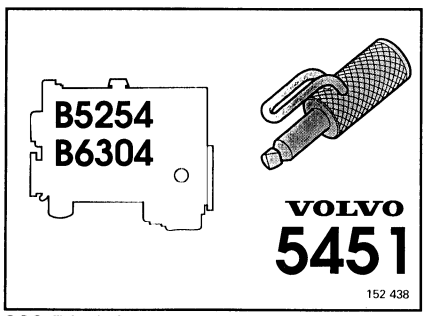
999 5433-1 S152 226



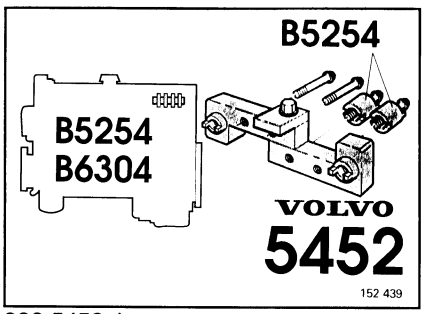
999 5449-7



999 5450-5



999 5451-3



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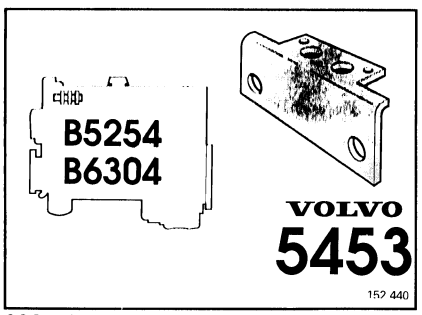

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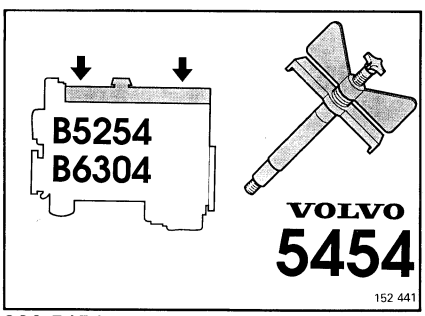
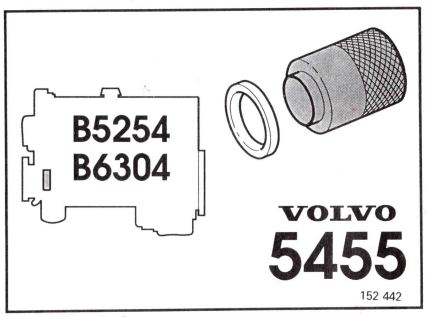
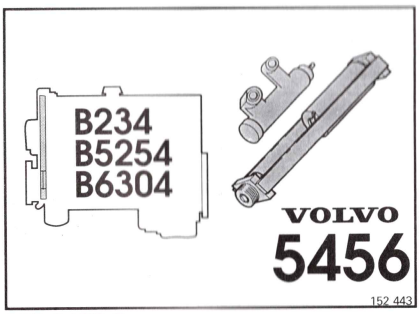


999 5454-7

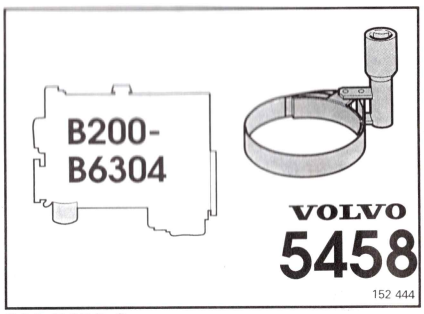
999	Description - use
5455-4	**Drift,** installing oil pump seal
5456-2	**Press tool,** compressing belt tensioner
5458-8	**Oil filter wrench,** removing oil filter
5464-6	**Lifting lug,** lifting engine (exhaust manifold)
5470-3	**Holder** (B 6304), removing/installing injectors (California)
5471-1	**Holder** (B 6304), removing/installing injectors (California)
5502-3	**Guide pins** (2x), installing bearing shells
5971-0	**Base,** magnetic stand
9639-9	**Dial gauge,** measuring tool



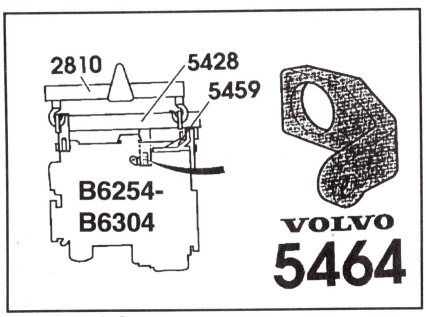
999 5455-4



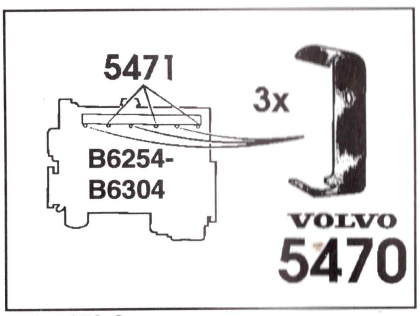
999 5456-2



999 5458-8



999 5464-6 S152 603



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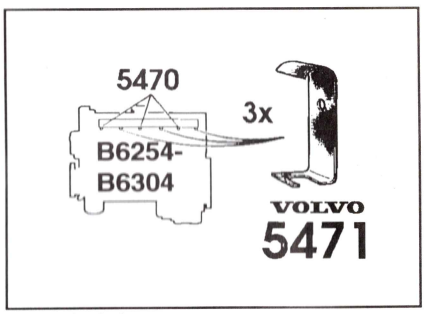

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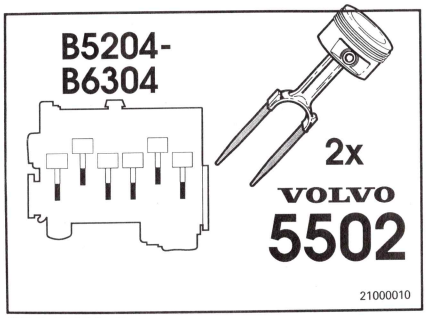
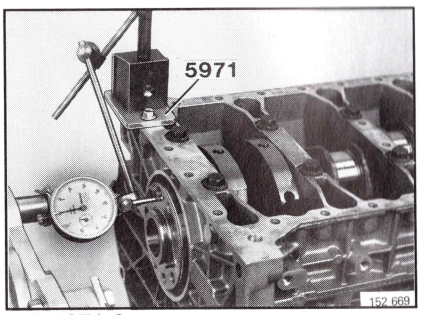
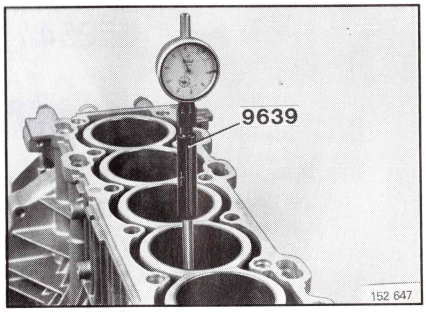


999 5502-3

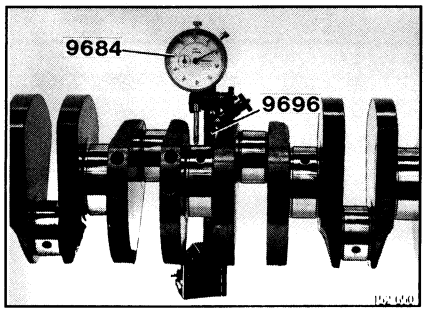


999 5971-0 S152 669

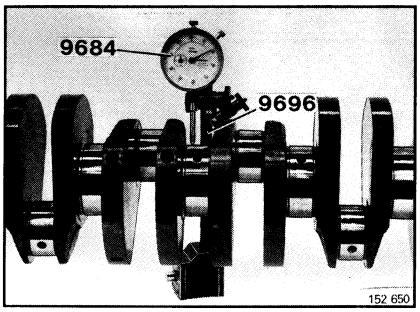


999 9639-9 S152 647

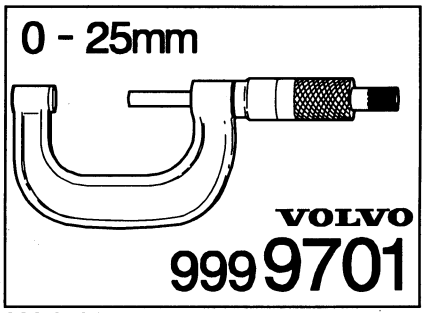
999	Description - use
9684-5	**Dial gauge,** checking crankshaft straightness
9696-9	**Magnetic stand,** dial gauge
9701-7	**Micrometer,** Ø 0–25 mm
9702-5	**Micrometer,** Ø 25–50 mm
9703-3	**Micrometer,** Ø 50–75 mm
9704-1	**Micrometer,** Ø 75–100 mm
9802-3	**Spring tester,** measuring spring load/length



999 9684-5



999 9696-9



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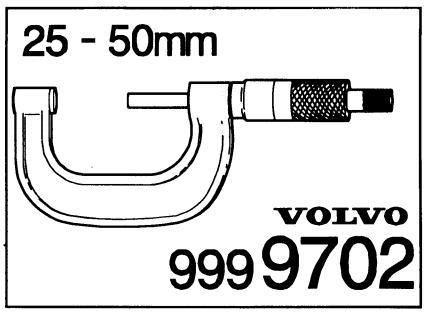
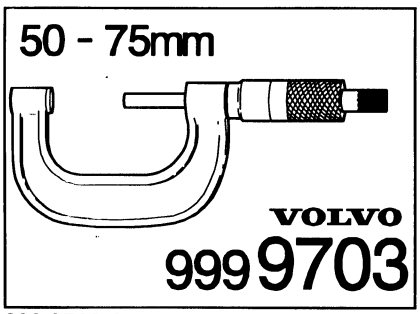
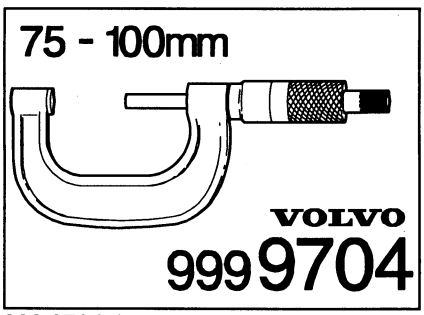


999 9702-5 08 00428



999 9703-3 08 00429



999 9704-1 08 00430

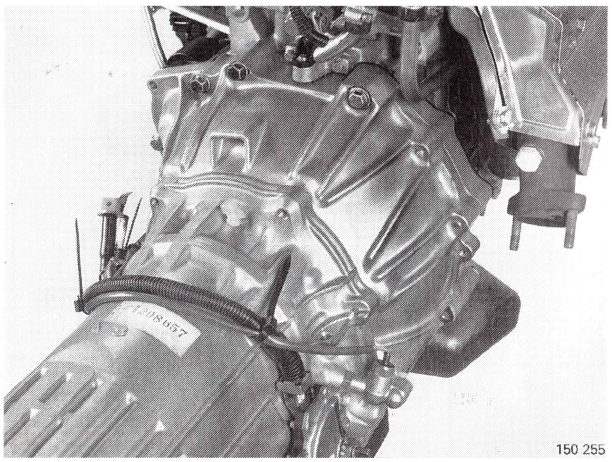
999 9802-3

Reconditioning

A. Cylinder head, exposure

Special tools: 999 2520, -2810, -5112, -5297, -5428, -5429, -5459, -5464,

This procedure starts from lifting out engine as per steps F1–20/21 in service manual: Section 2 (20–22, 25–26) (960)


150 255

A1

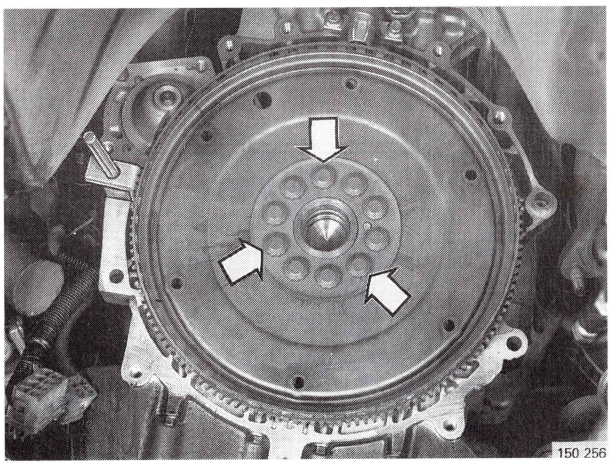
Remove gearbox

Removing gearbox: See section 4 (43).

Remove starter motor.

Automatics: Remove dipstick and pipe.
Remove torque converter bolts.

We recommend undoing the lower gearbox/engine bolts (which are difficult to reach) before putting the engine assembly on the floor (on a suitable underlay). Take the weight off the gearbox. Undo the remaining bolts and remove the gearbox **carefully**.


150 256

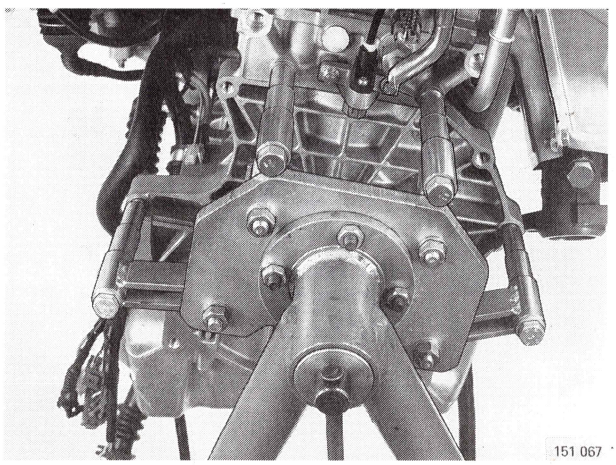
A2

Remove flywheel/carrier plate

Use gear segment 999 **5112**.

Remove flywheel.

Automatics: Remove carrier plate.


151 067

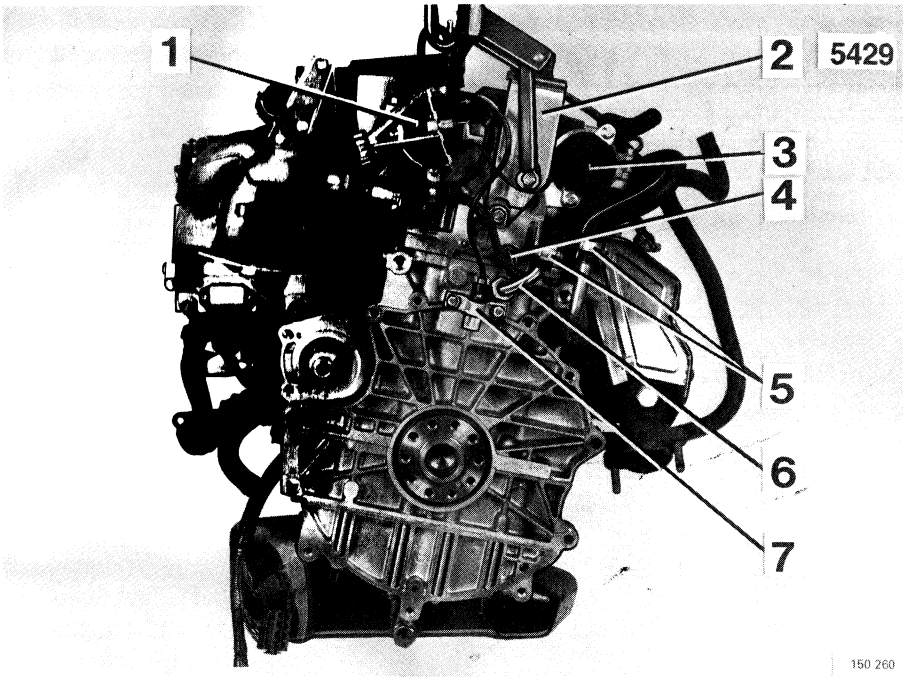
A3

Mount engine on stand

Use stand 999 **2520** and fixture 999 **5297**.

Remove lifting tools.

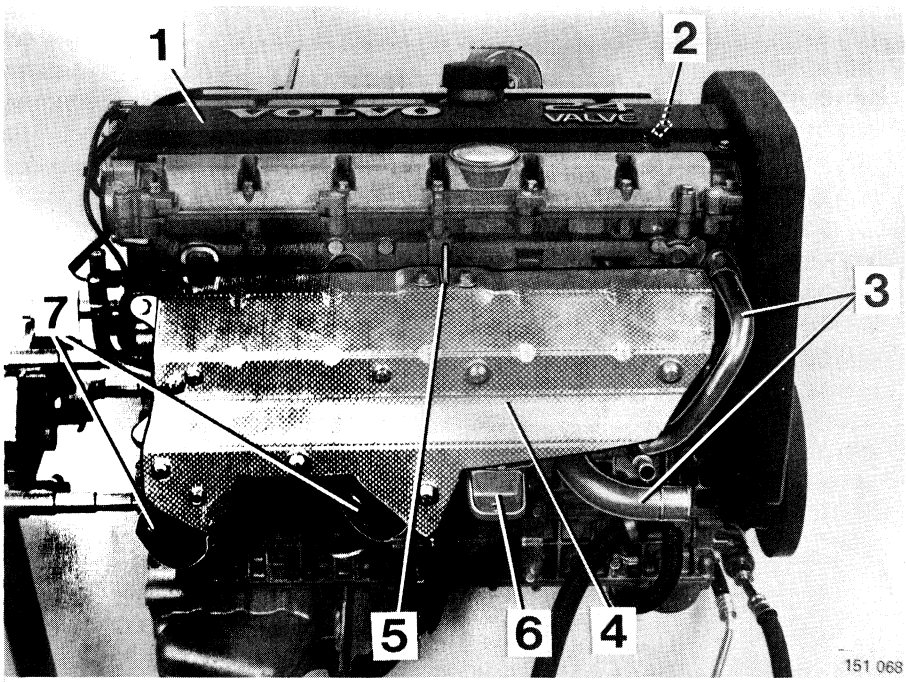
Stripping, rear end
B 6244, B 6254, B6304



A5

1. Connector mounting brackets
2. Lifting lug (5429)
3. CMP sensor
4. ECT sensor
5. Coolant hoses
6. Coolant pipe
7. RPM sensor

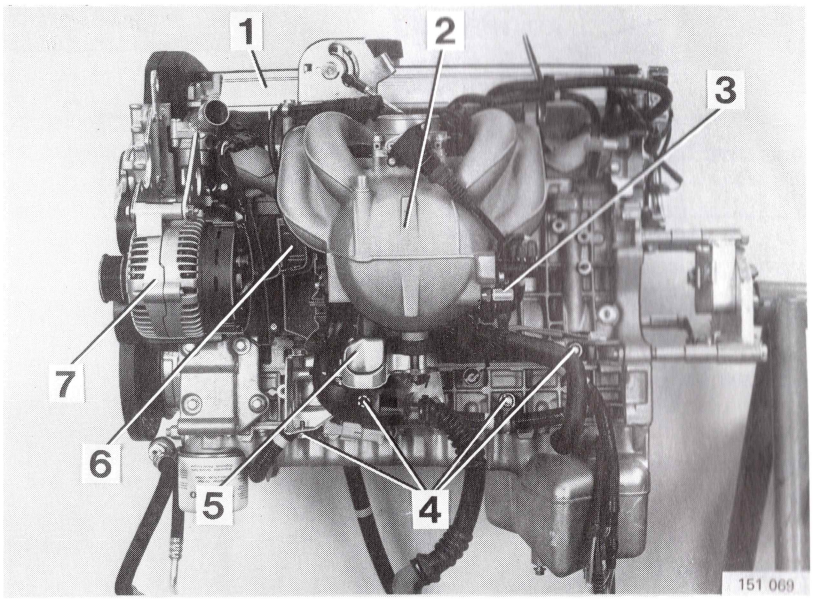
Stripping, exhaust side
B 6244, B 6254, B6304



1. Sparkplug cover
2. Ignition coils
3. Coolant pipe
4. Heat shield
5. Lifting lug
6. RH engine mounting
7. Exhaust manifold

A6

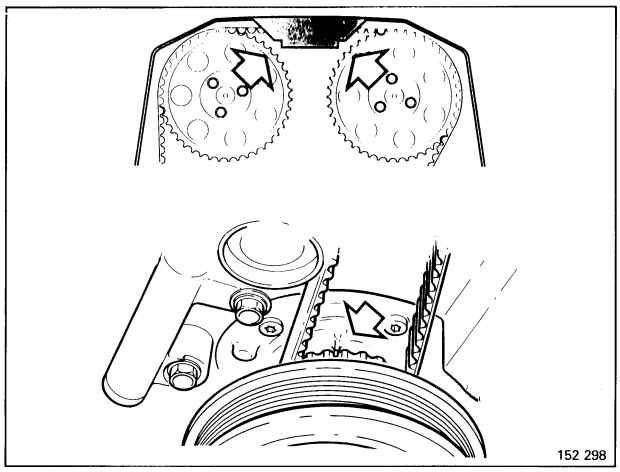
Stripping, intake side
B6244, B 6254, B6304



1. Injectors and fuel distribution manifold
2. Intake manifold
3. Knock sensor (2x)
4. Cable harness
5. LH engine mounting and bump stop
6. Oil trap and hoses
7. Auxiliaries mounting bracket

B. Timing belt and drive assembly, dismantling

Special tools: 998 8500, 999 5433, -5456

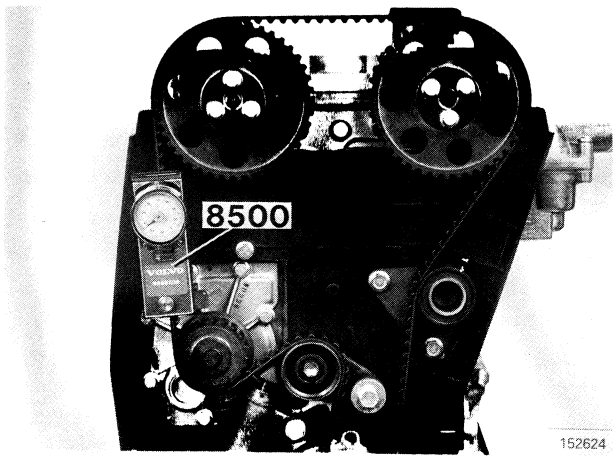


B1

Align camshaft/crankshaft timing marks

Remove front timing belt cover.

Align timing marks as shown.



B2

Measure belt tension

Place gauge 998 **8500** midway between exhaust camshaft pulley and coolant pump.

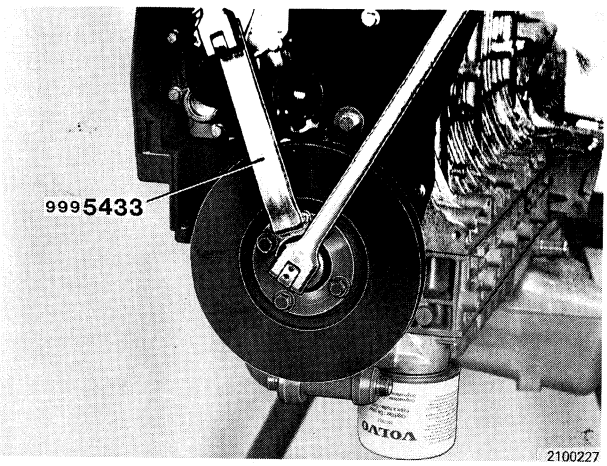
Read gauge. Belt tensioner **must** be replaced if reading is **out of limits**.

Belt tension should be within the following limits:

21 mm belt .....**3.5-4.6 units**

23 mm belt .....**2.7-4.2 units**

28 mm belt .....**2.5-3.5 units**



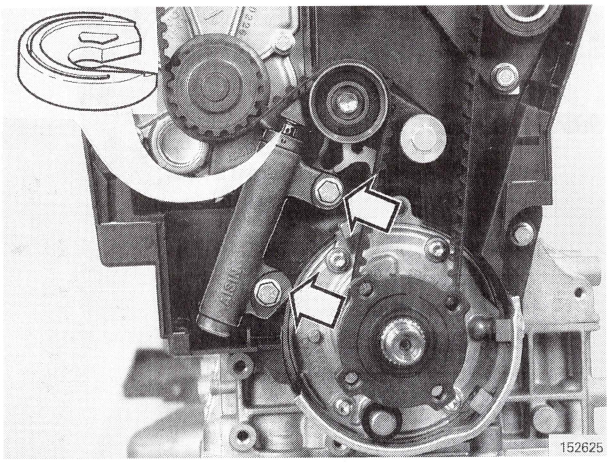
B3

Remove vibration damper

Use counterhold 999 **5433**, attach to vibration damper.

Remove vibration damper.

Remove upper transmission cover.



B4

Remove timing belt

Remove lower belt guard (snowguard).

Undo and remove upper tensioner bolt.

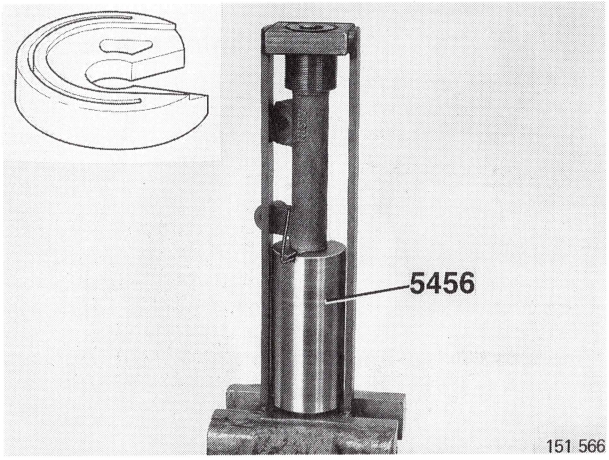
Undo lower belt.

Twist tensioner to free pulley.

Remove lower bolt, tensioner and timing belt.

Check there are no visible leaks.

Manual engines: *Remove play control washer.*

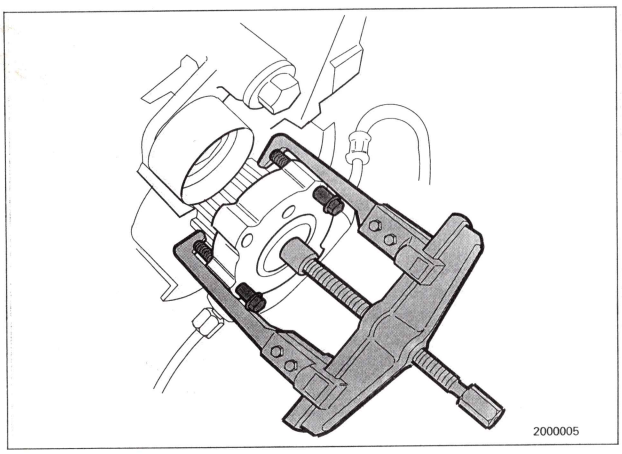


B5

Compress belt tensioner

Compress belt tensioner using tool 999 **5456**. Place tensioner in tool and tighten center tool nut fully. Wait until tensioner is fully compressed (approx. 5 min.) and insert locking pin (∅ 2 mm) in piston.

> **Note:** Tensioner **must** be replaced if leakage is visible, if there is no resistance to compression or if component cannot be compressed.



B6

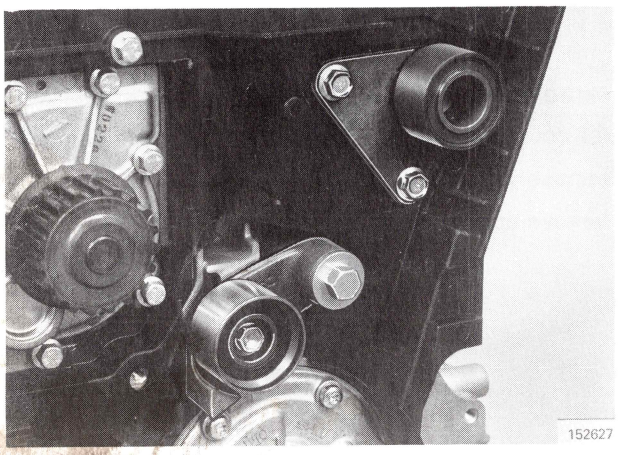
Remove belt drive pulley from crankshaft

Use universal extractor and two vibration damper bolts.

Hand-tighten the two bolts in the pulley as far as they will go.

Attach extractor so that arms act on bolts (not on the pulley itself).

> **Note:** Make sure that tool arms do not damage pulley teeth. Check bolts and pulley for any signs of damage.



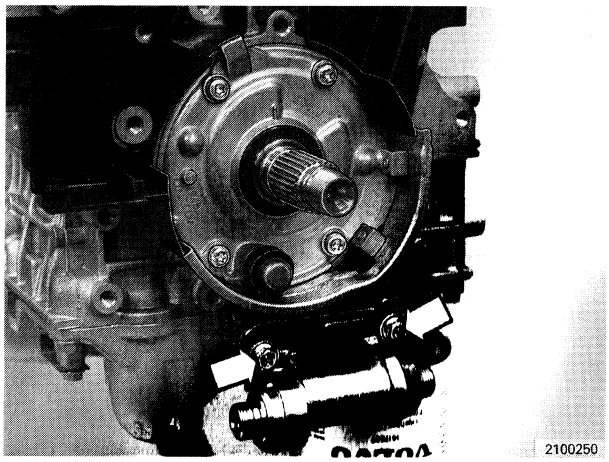
B7

Remove tensioner and idler pulleys

Check pulley surfaces and bearings.

Spin pulleys and listen for noise, check for any play in bearings.

Check that pulley surfaces are smooth and clean.


2100250

B8

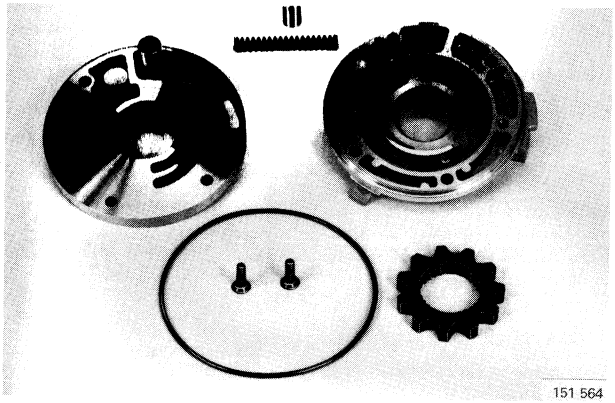
Remove oil pump

Remove four oil pump mounting bolts.

Pry pump off **carefully**, using a screwdriver inserted behind the prising lug.

Clean joint faces and mating surfaces.

Remove oil cooler thermostat casing.


151 564

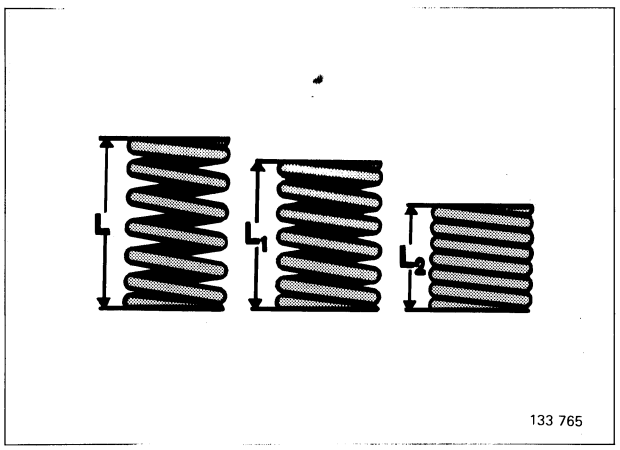
B9

Dismantle oil pump

Clean and inspect all components.

Inspect components for damage and wear, paying particular attention to half-moon-shaped insert (surface between suction and delivery sides). Replace complete pump if any component is defective.

(Relief valve parts available separately.)



133 765

B10

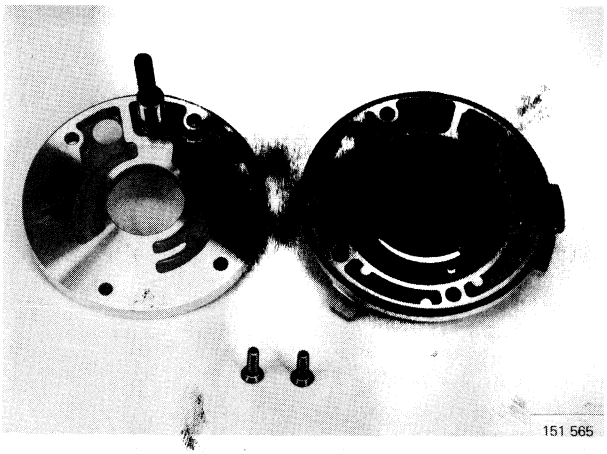
Test relief valve springs:

(P/N 1397819)

Load (N)	Length (mm)
0	**76.22**
52±4	**56.10**
85±8	**39.90**

(P/N 9135202) later version

0	**76.22**
59±4	**56.10**
108±8	**39.90**


151 565

B11

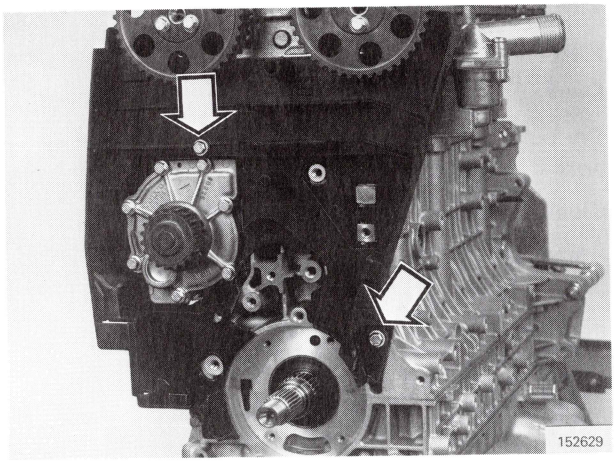
Put pump wheel in casing and check for clearance/play

Lay large pump wheel in position with marking facing upwards.

Put small wheel in position.

Check clearance/play. If excessive, replace complete pump. Reassemble pump.

Important: If the measured clearance between the outer rotor and casing is greater than **0.35 mm and the oil pressure is less than 1 bar (14.5 psi) at an oil temperature of 100°C (112°F)**, the oil pump should be replaced. Measure clearance with a feeler gauge.



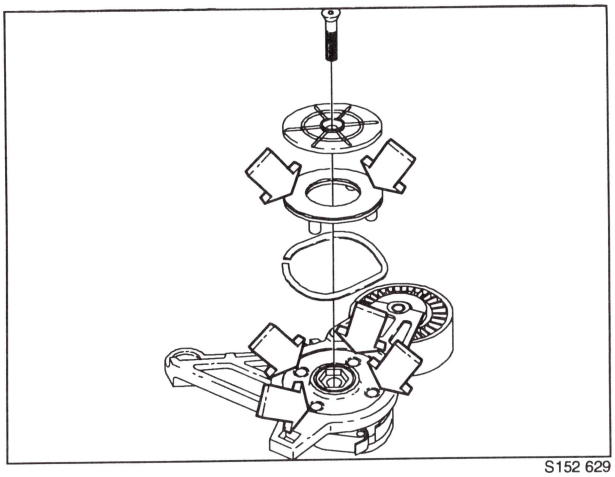
B12

Remove coolant pump and inner transmission cover

Remove coolant pump.

Clean joint face and mating surfaces, removing all remains of original gasket.

Remove inner transmission cover.



B13

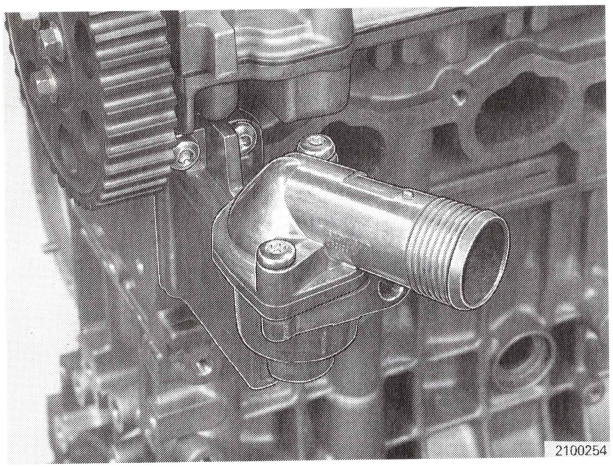
Greasing automatic tensioner pulley (Applies to earlier types)

Remove center tensioner bolt and dismantle as shown in picture.

Apply grease P/N 1 161 246-2 (50g) or 1 161 247-0 (500g) between friction plate and cover, and to the four spring holes (arrowed).

Reassemble belt tensioner, tighten center bolt. **20 Nm (15 ft.lb.).**

For later types: replace tensioner if necessary.



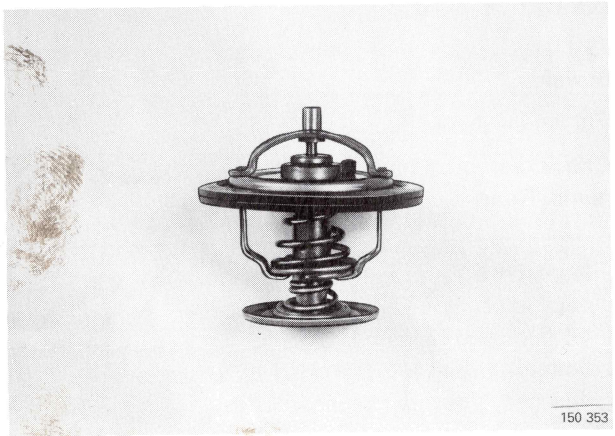
B14

Remove coolant thermostat

Remove thermostat and gasket (Torx 40 bolts).

Clean joint faces and mating surfaces.

Remove thermostat casing.



B15

Thermostat, checking opening

Thermostat can be tested in hot water.

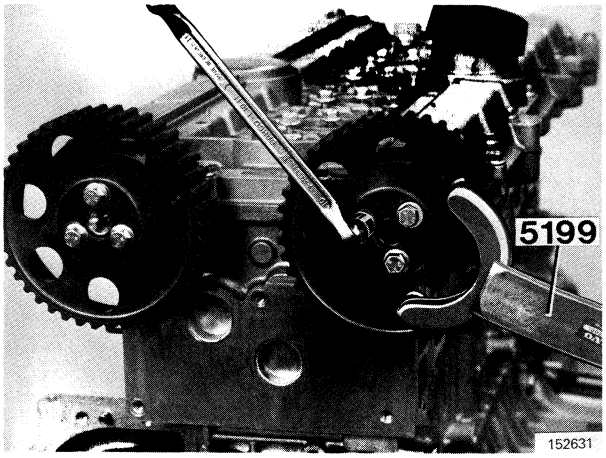
Maximum opening should be reached in two minutes in water at specified opening temperature.

Marking	**87**
Starts opening at	**87°C (187°F)**
Wide open at	**102°C (216°F)**
Marking	**90**
Starts opening at	**90°C (194°F)**
Wide open at	**105°C (221°F)**

C. Cylinder head, removal

Special tools: 999 5199, -5454, -5670

C1



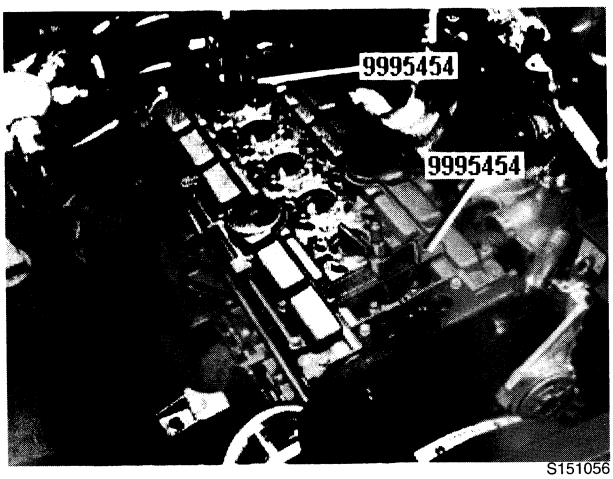
Remove camshaft pulleys

Mark pulleys (intake and exhaust).

Use counterhold 999 **5199**.

Important: Camshaft pulleys **must not be rotated** when removing timing belt, as this may damage valves.

C2



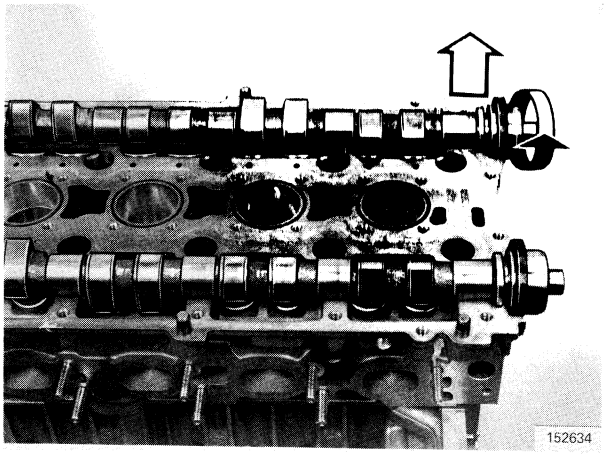
Remove upper half of cylinder head

Install tool 999 **5454** with a few millimeters play to the camshaft housing cover, remove all screws.

Disconnect camshaft cover with pliers 999 **5670** at stop lugs. Start with cylinder 1 and work alternately backward.

Open and slacken off tools 999 **5454** step by step so that parallel movement is ensured when removing camshaft housing cover.

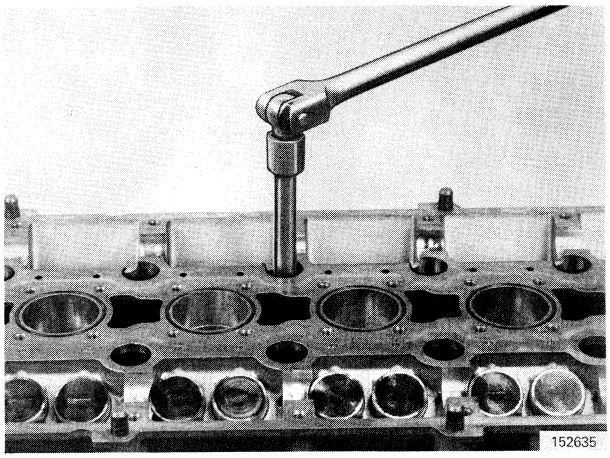
C3



Remove camshafts

Twist camshafts and lift out simultaneously. Avoid damaging axial guides.

(This makes taking the camshafts out of the axial guides easier.)

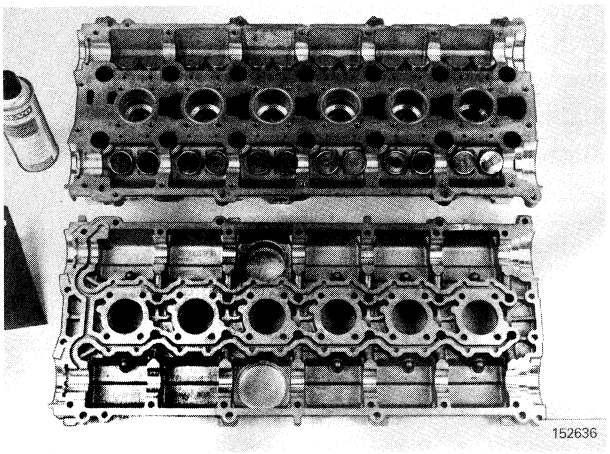


C4

Remove cylinder head

Undo bolted joints (working from outside and in).

Remove cylinder head and gasket from cylinder block.



C5

Clean mating faces

Clean mating faces on upper and lower halves of cylinder head.

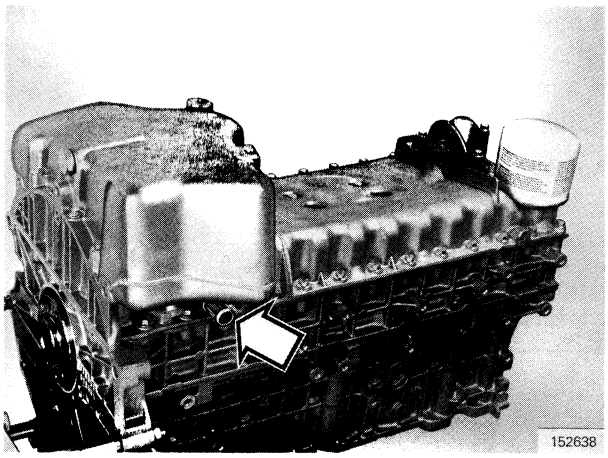
Use gasket remover P/N **1 161 340-3**.

Scrape surfaces clean **carefully** using a soft putty knife.

Rinse clean with water and dry surfaces with alcohol.

> **Note: Always** use a fume hood or extractor when using gasket remover.

D. Crank mechanism, dismantling



D1

Remove oil sump

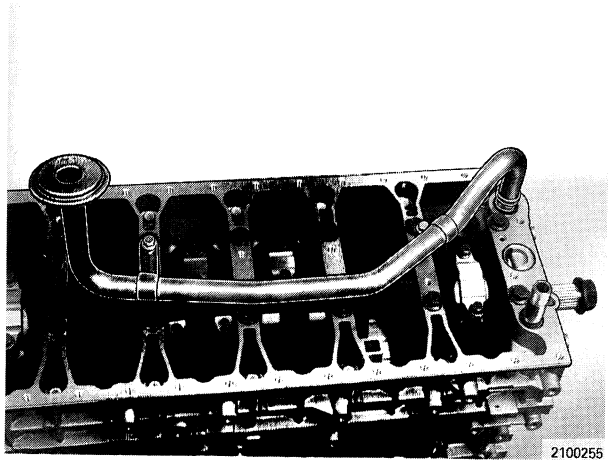
Remove oil filter.

Disconnect flame trap return line.

Remove oil sump.

Tap sump off **carefully** using a plastic mallet.

Remove oil passage oil rings.

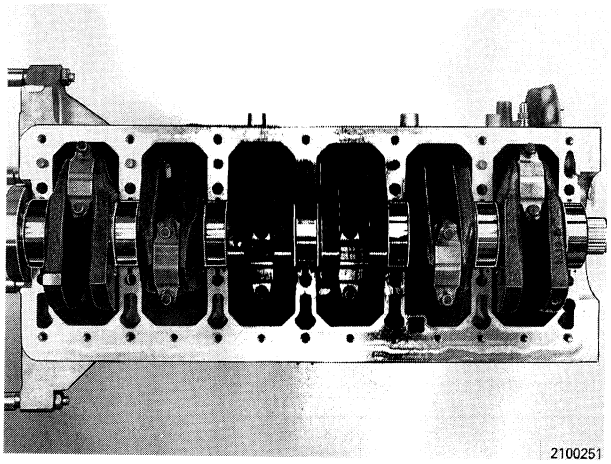


D2

Remove oil pump suction pipe

Clean and inspect pipe and strainer.

Remove O-ring.



D3

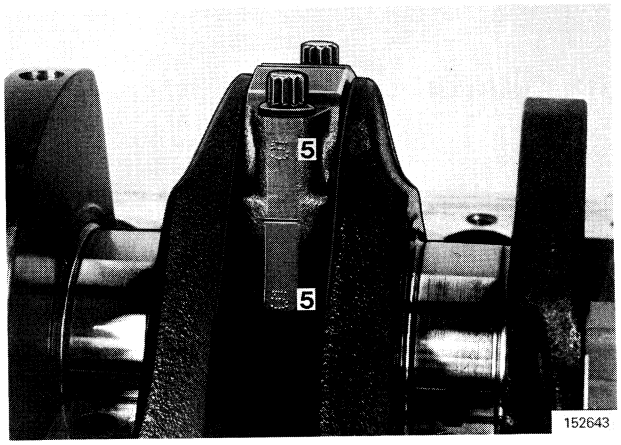
Remove intermediate section

Undo intermediate section bolts, working from the sides inwards towards the center.

Tap intermediate section off **carefully** with a plastic mallet.

Remove rear crankshaft seal.

Important: Do **not** let crankshaft rotate.



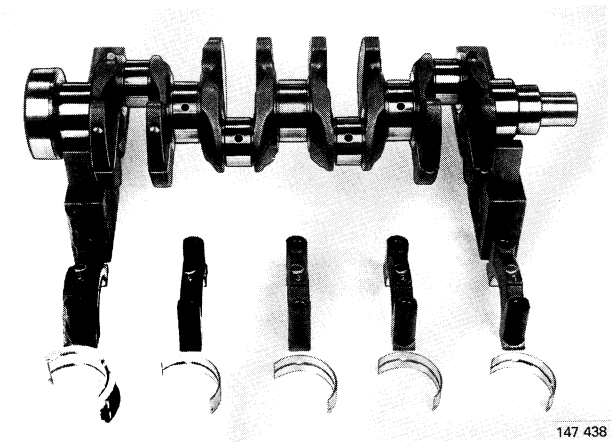
D4

Remove big end bearing caps

Check markings on caps and conrods. Mark with center or number punch as required.

Check centering of bearing halves on conrods and caps.

Important: Do not mix up bearing shells for different crankshaft bushings. Do **not** rotate crankshaft.



D5

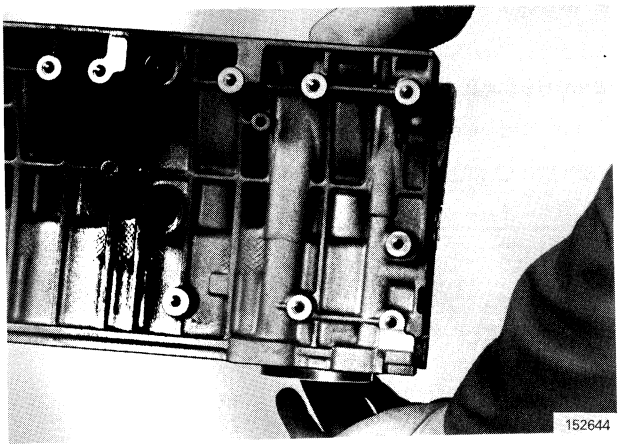
Lift crankshaft out of engine block

Support crankshaft in V-blocks on outermost two main journals.

Remove remaining main bearing shells from block.

Mark position of thrust bearing.

Note: Do not mix up bearing shells from the different main journals.

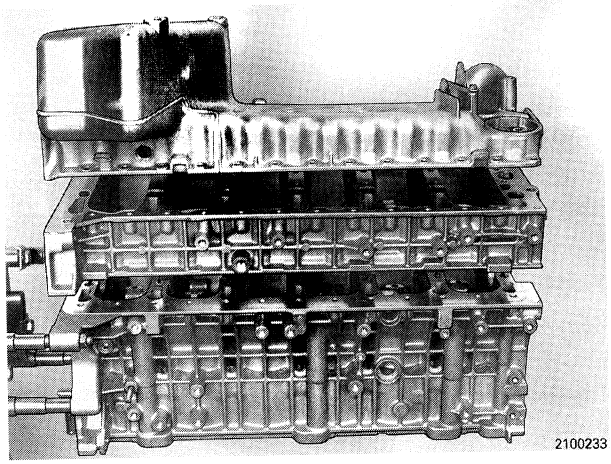


D6

Remove pistons from engine block

Push pistons **carefully** by hand to overcome friction from rings.

Remove pistons and conrods from bores.



D7

Clean joint faces

Clean joint faces on cylinder block, intermediate section and oil sump.

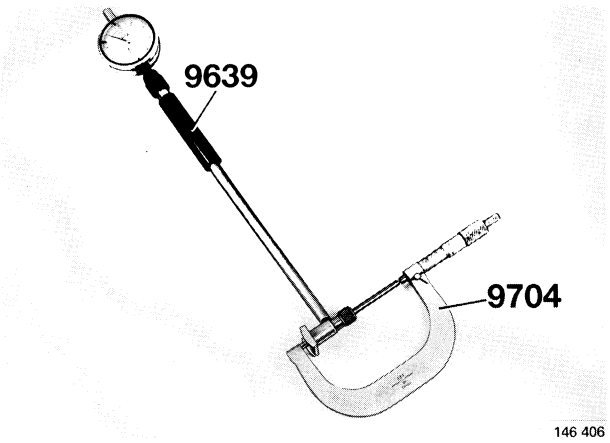
Carefully scrape surfaces clean with a soft putty knife.

Use gasket removed P/N **1 161 340-3** if necessary.

Note: Always use a fume hood or extractor when using gasket remover.

E. Cylinder block, measurement

Special tool: 999 9639, -9704



E1

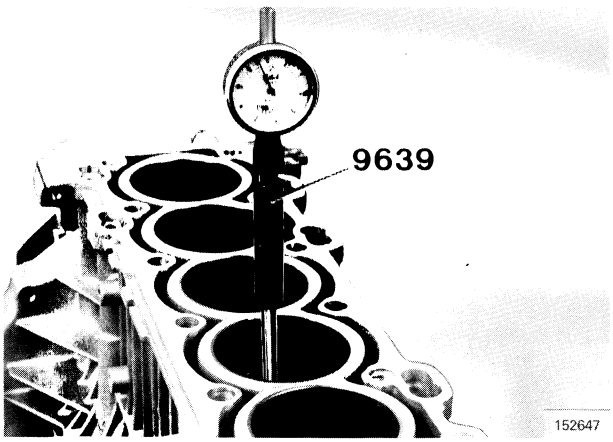
Measure cylinder bores

Wipe bores clean and inspect visually.

Measure bores using dial gauge 999 **9639** (50–100 mm), micrometer 999 **9704** and a micrometer stand.

Set micrometer to bore diameter plus **max.** tolerance as marked on block.

Calibrate dial gauge using micrometer.

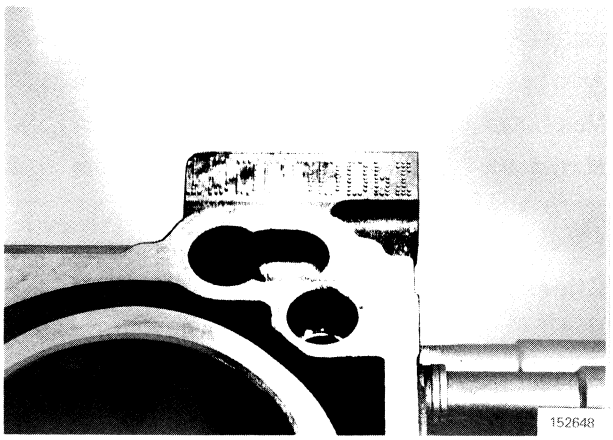


E2

Measure wear

Measure **maximum wear** at right angles to engine centerline immediately underneath TDC.

Measure **minimum wear** in line with centerline at BDC.



E3

Classification

Each cylinder is identified by a classification marking (C,D,E or G) punched in the rear of the block.

Oversize bores are indicated by abbreviations OS1 or OS2 as appropriate. This marking must be applied after reboring.

Cylinder bore diameter

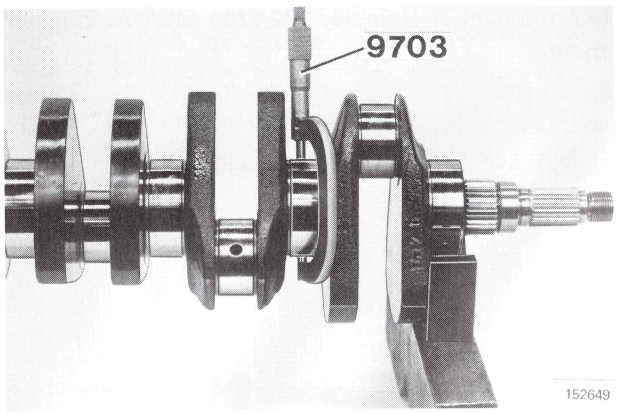
Standard		**B6244/B6254**	**B6304**
Bores marked C	**mm**	81.00–81.01	83.00–83.01
Bores marked D	**mm**	81.01–81.02	83.01–83.02
Bores marked E	**mm**	81.02–81.03	83.02–83.03
Bores marked G	**mm**	81.04–81.05	83.04–83.05
Oversize			
OS1	**mm**	81.20–81.21	83.20–83.21
OS2			

Cylinders should be rebored when wear reaches 0.10 mm.

F. Crank mechanism, measurement

Special tools: 998 5424, 999 2413, -5309, -9696, -9684, -9701, -9702, -9703, -9704

Crank mechanism, measurement F1–12
Conrod bushings, replacement F13–16

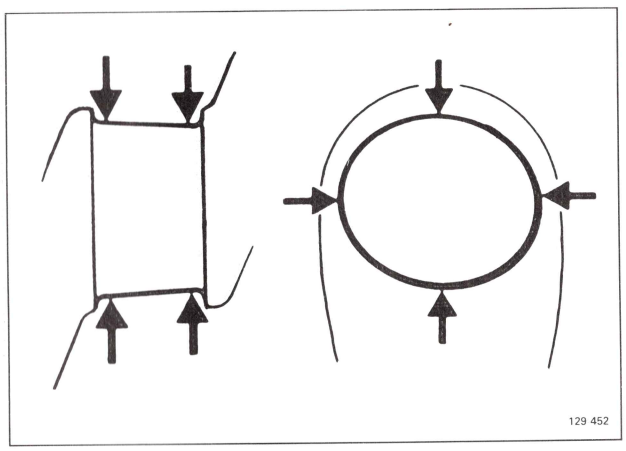


F1

Measure crankshaft

Use micrometer 999 **9703.**

Measure out-of-round and ovality of bearing journals. Measure at several points around circumference and along length.



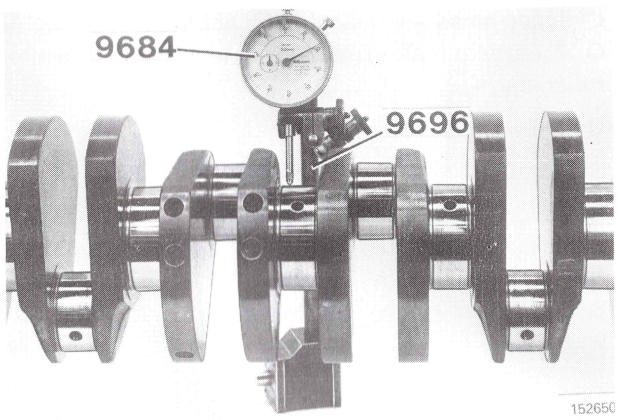
F2

Crank pins

Diameter, standard	**mm 50.000**
undersize	**mm 49.750**
Bearing seat width	**mm 26.000**
Max. out-of-round	**mm 0.004**
Max. ovality	**mm 0.004**

Main bearing journals

Diameter, standard	**mm 65.000**
undersize	**mm 49.750**
Axial bearing seat width	**mm 26.000**
Max. out-of-round	**mm 0.004**
Max. ovality	**mm 0.004**



F3

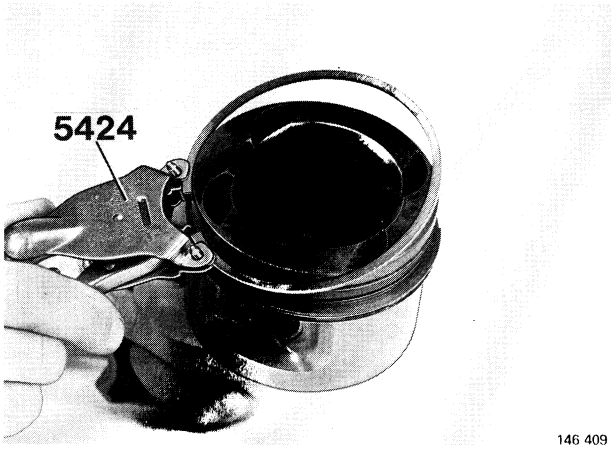
Check crankshaft straightness

Use dial gauge 999 **9684** and magnetic stand 999 **9696.**

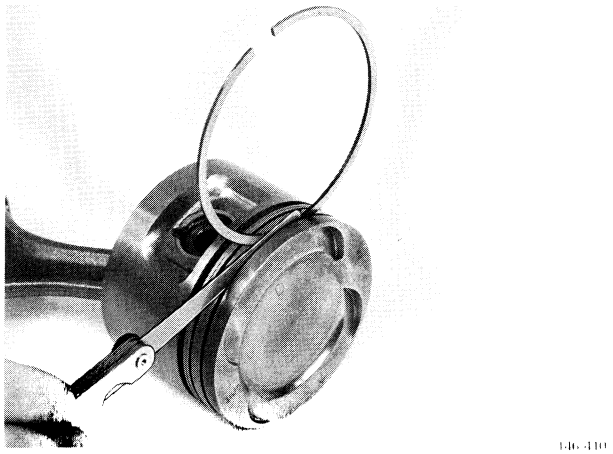
Support outermost main bearing journals in V-blocks.

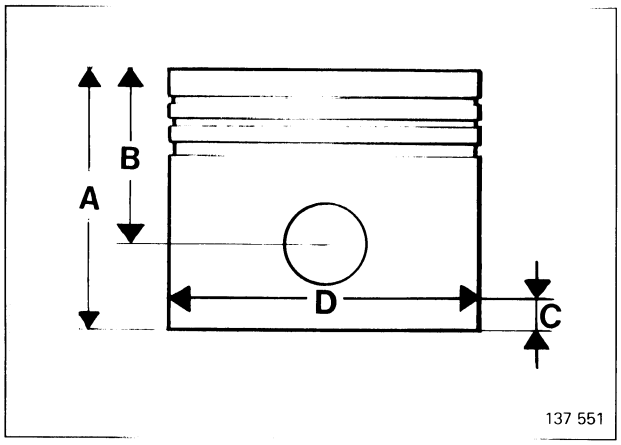
Turn crankshaft and measure radial throw of other main bearing journals.

Max. radial throw . . . . . **mm 0.004**



146 409





137 551

Engine type	Dimensions in mm		
	A	B	C
B 6244	59.9	35.9	16.0
B 6254	59.9	35.9	16.0
B 6304	59.9	35.9	16.0

F4

Remove piston rings

Use piston ring pliers 998 **5424.**

Remove carbon deposits. Clean piston ring grooves by scraping with a scraping tool or fragment of ground piston ring.

Check for:
- damage
- wear
- cracking

F5

Check piston ring side play

Use **new** rings.

Upper compression ring: ..... **mm 0.05-0.085**

Lower compression ring: ..... **mm 0.03-0.065**

Oil scraper ring: ..... **mm 0.02-0.055**

Dimensions, version 1

Upper compression ring ..... **mm 1.5**

Lower compression ring ..... **mm 1.75**

Oil scraper ring ..... **mm 3.0**

Dimensions, version 2 (1994-)

Upper compression ring ..... **mm 1.2**

Lower compression ring ..... **mm 1.75**

Oil scraper ring ..... **mm 3.0**

F6

Measure piston diameter

Use micrometer 999 **9704** and sliding calipers.

A = Overall piston height.
B = Height from gudgeon pin center to crown.
C = Measure piston diameter at right-angles to gudgeon pin hole at distance C from edge of skirt.
D = Diameter.

Dimensions A, B and C, see table.

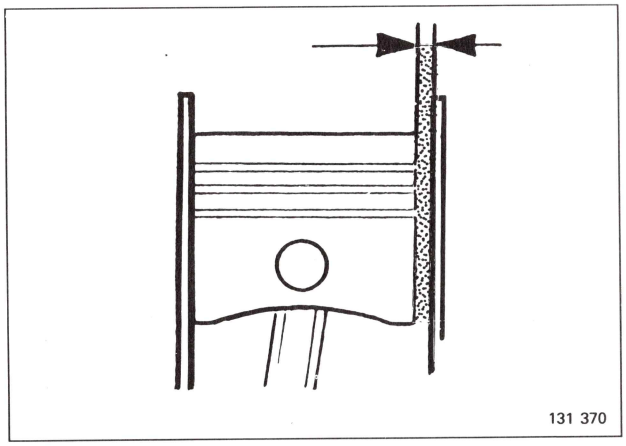
Piston diameter (D)

Standard		B6244/B6254	B6304
Piston marked C	**mm**	80.98–80.99	82.98–82.99
Piston marked D	**mm**	80.99–81.00	82.99–83.00
Piston marked E	**mm**	81.00–81.01	83.00–83.01
Piston marked G	**mm**	81.017–81.032	83.017–83.032

Oversize

Oversize 1	**mm**	81.177–81.192	83.177–83.192
Oversize 2	**mm**	81.377–81.392	83.377–83.392

Max. difference in weight between pistons in same engine: ..... **10 g**



F7

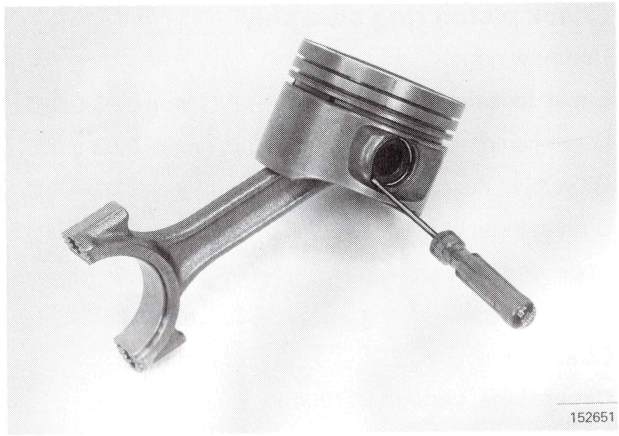
Calculate piston clearance

*Measured cylinder diameter	**mm**	B6244/B6254 96.02	B6304 96.03
Measured piston diameter:	**mm**	-96.01	-96.00
piston clearance =	**mm**	0.01 (min)	0.03 (max)

Piston clearance should be:

B 6244, B 6254, B 6304 . . . . . **mm** 0.01–0.03

*For measurement of cylinder bores see steps **E1–E3.**



F8

Separate conrods and pistons

First check that piston and conrod are marked. (Conrod see step D4).

Pry circlip out **carefully** with a screwdriver. Push gudgeon pin out by hand.

Clean and inspect conrods, bearing caps and bolts for damage, wear and cracking.

Check length of conrod bearing cap bolts using sliding calipers.

Max. length . . . . . **mm 55**

F9

Check gudgeon pin fit in pistons

No play is allowed. Gudgeon pin should slide gently but firmly through hole when pressed with thumb.

If there is any play, replace piston.

F10

Check gudegon pin fit to conrods

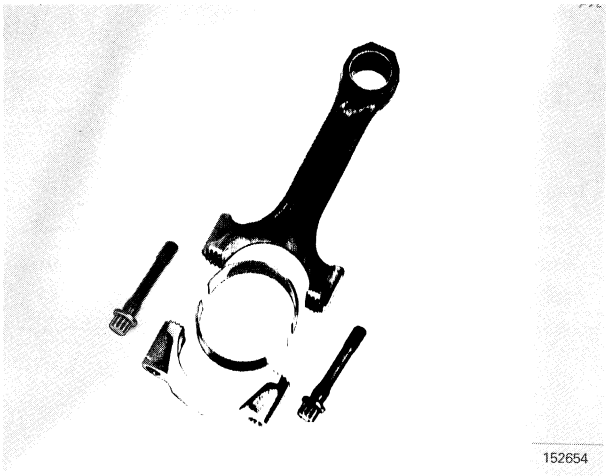
Gudgeon pin should slide through hole when pressed gently with thumb.

If excessive play, measure gudgeon pin and fit new conrod bushing if necessary.

Use micrometer 999 **9701.**

Gudgeon pin diameter:

B 6244, B 6254, B 6304 . . . . . **mm** $23.0^{+0}_{-0.004}$


152654

F11

Check bearing seats at big end of conrod

Inspect bearing shells visually.

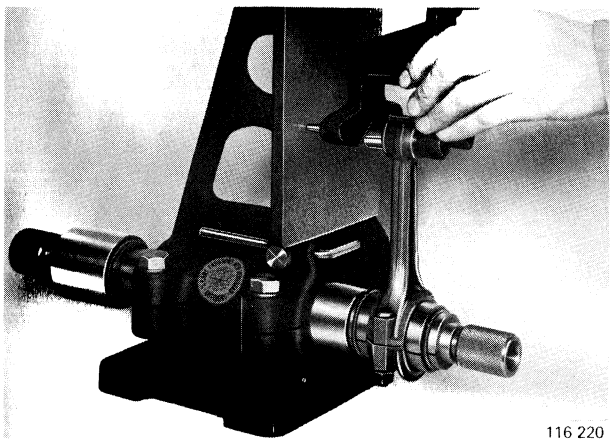
If in doubt, measure out-of-round.

Use dial gauge 999 **9639.**

Bearing seat diameter:

B 6244, B 6254, B 6304 ..... **mm 53.0**

Max. out-of-round ..... **mm 0.006**


116 220

F12

Check conrod in alignment gauge

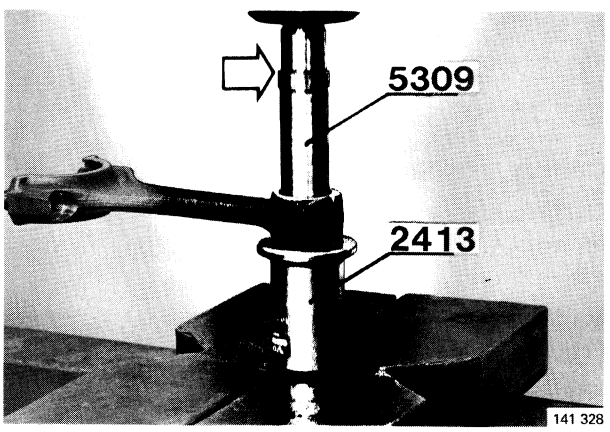
Check straightness and twisting.

Important: Check that clamping surface of fork is round and free of burrs.

Release and tighten expander at big end between each alignment check.

Conrod bushings, replacement

Steps *F13-F16*



141 328

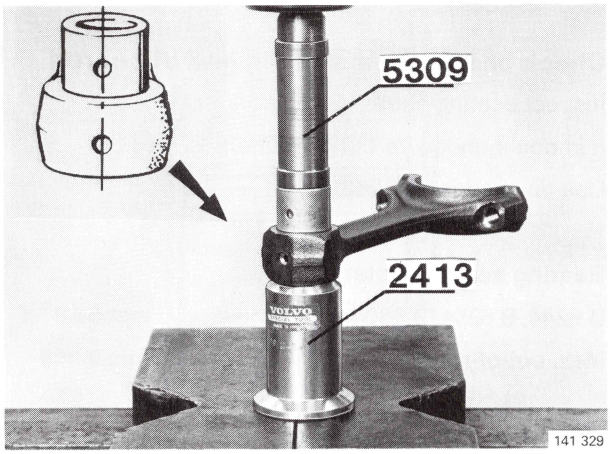
F13

Press bushing out

Use drift 999 **5309.**

Position drift correctly with short end downwards.

Use drift 999 **2413** as counterhold.



F14

Press in new bushing

Use drift 999 **5309.**

Position drift correctly, long end downwards.

Push drift right down.

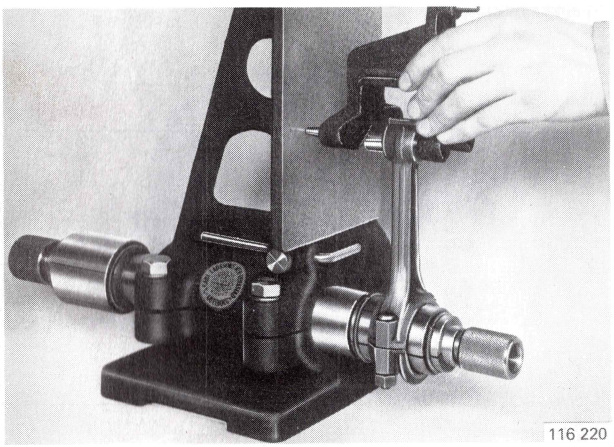
Important: Make sure that hole in bushing is aligned with lubricating passage in conrod.

F15

Check gudgeon pin fit to new bushing.

Gudgeon pin should slide through bushing under light thumb pressure, but without noticeable play.

Machine bushing as necessary.

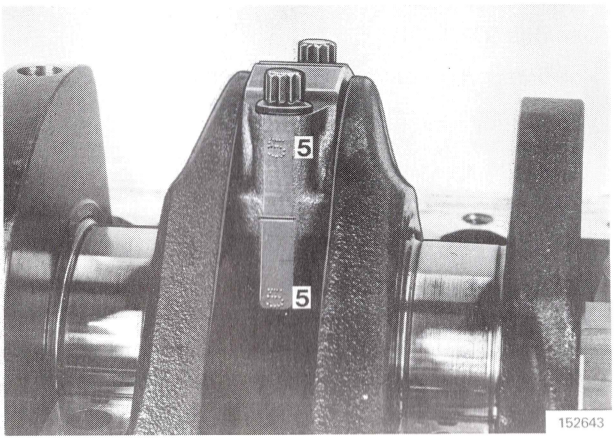


F16

Check conrod in alignment gauge

Check for straightness and twisting.

Important: Check that clamping surface of fork is round and free of burrs. Release and tighten expander at big end between each alignment check.



F17

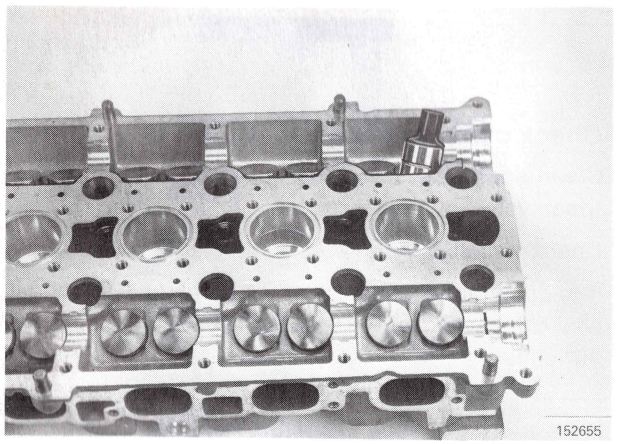
Conrod, replacement

Conrods are symmetrical and can be turned over if required.

Markings: Assemble conrod (tighten bolts to **20 Nm (15 ft.lb.)**) and check that bearing cap is correctly positioned.
Put big end in clamp using copper spacers or similar tool. Mark both halves with the cylinder number using a center or number punch.

G. Cylinder head, measurement/reconditioning

Special tools: 115 8280, 951 2051, 998 6052, 999 5219, -5222, -5363, -5364, -5365, -5373, -5379, -5505, -9802



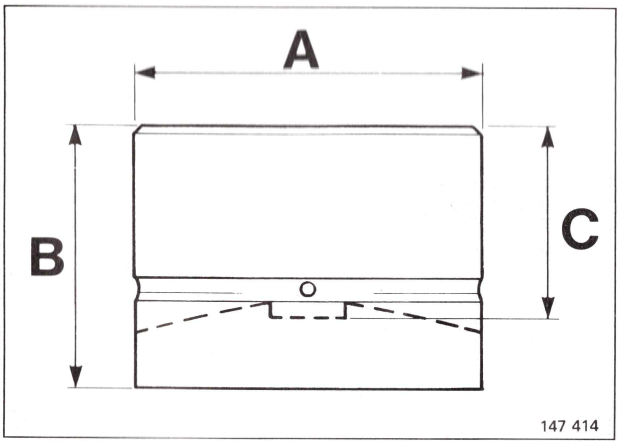
G1

Remove tappets (valve lifters) from cylinder head

Use magnet or suction cup to assist in removing tappets.

Check tappets for signs of wear. Measure as required.

> **Note:** Store tappets upside down to prevent oil draining out. Ensure tappets are placed in order - do not interchange components.
> Put tappets in oil-filled container if storing for any length of time.



Tappet dimensions

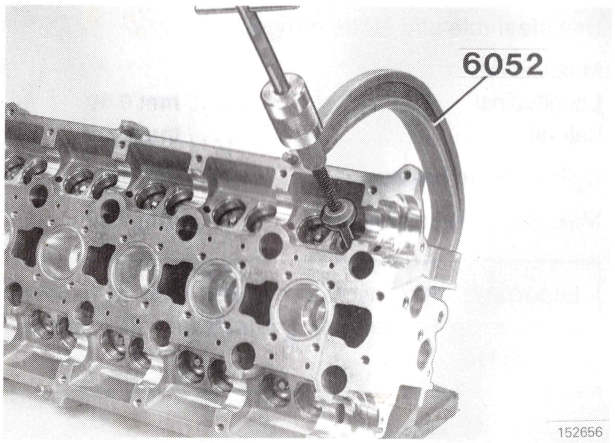
A External diameter: . . . . . **mm** $32^{+0.025}_{-0.041}$

B External height: . . . . . **mm** 26 ± 0.5

Distance between top of tappet and piston

C(1) Unloaded: . . . . . **mm 18.40**

C(2) Compressed: . . . . . **mm** $16.15^{+0.3}_{-0.1}$



G2

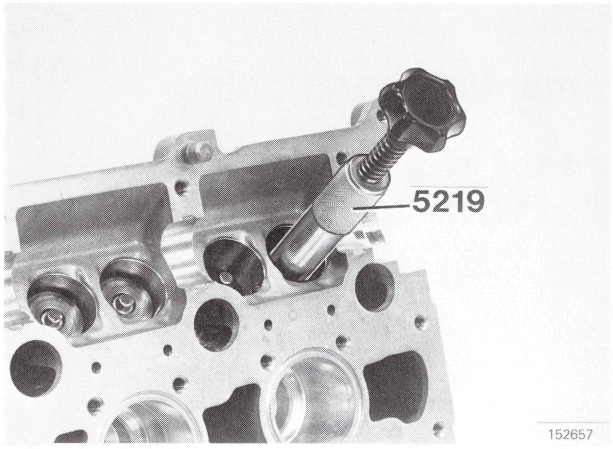
Remove valves

Use valve clamp 998 **6052** and clamp 951 **2051**.

Remove:

- valve collets
- upper spring collars
- valve springs
- valves

> **NOTE: Check** positions of moving parts **carefully.**



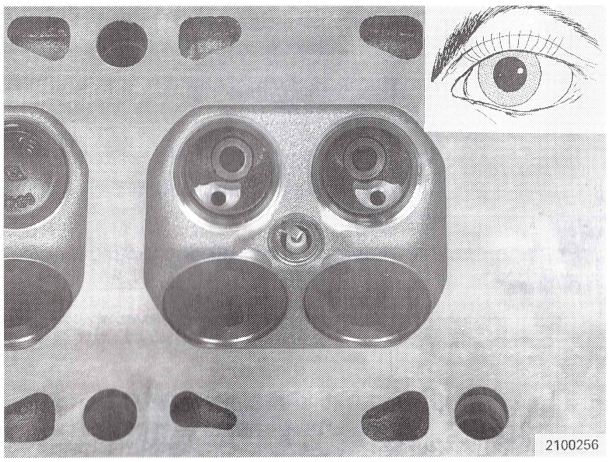
G3

Remove valve stem seats

Use tool 999 **5219.**

Remove seals and lower spring collars.

Clean cylinder head:
- joint faces
- combustion chambers
- intake/exhaust ports
- valve seats



G4

Check cylinder head

Clean sparkplug socket threads (use M14×1.25 tap). Clean valves, valve springs and spring collars.

Check visually for damage.

If in doubt as to whether valve seats are cracked, mill seat clean using tool 115 **8280** with Ø7 mm spindle and 45° cutter.

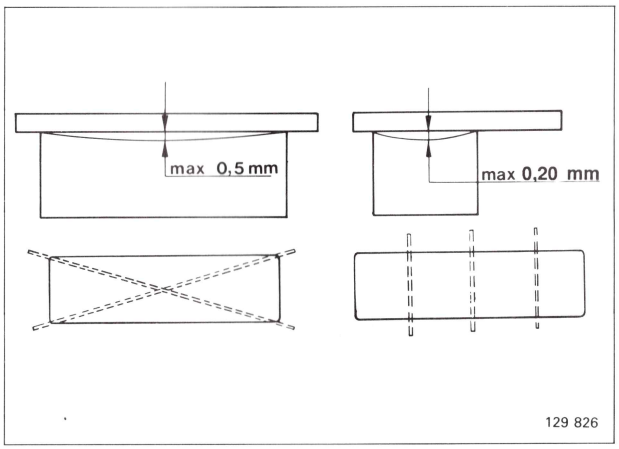
Air intake ducts, cleaning:
(1995 models onwards)
Scrape hole clean (Ø 4 mm) as far as possible. Blow air intake ducts clean with compressed air from intake side, on top of cylinder head. Check that air is getting through.

Note: Check that the reaming tool does not come into contact with the combustion chamber walls.

Valve seat width

Intake ..... **mm 1.4-1.8**

Exhaust ..... **mm 1.8-2.2**



G5

Measure cylinder head distortion

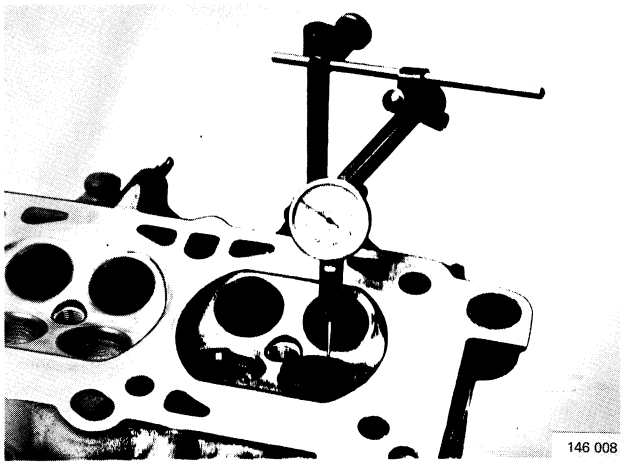
Use steel rule and feeler gauges.

Max. distortion:
Longitudinal ..... **mm 0.50**
Lateral ..... **mm 0.05**

Cylinder head height: ..... **mm 129.0**±0.05

Max. machining allowance: ..... **mm 0.30**

Important: Only machine cylinder head to remove scoring or corrosion on joint faces if head is undistorted.


146 008

G6

Measure valve guide wear

Use magnetic stand and dial gauge. Lift valve **approx. 2-3 mm** clear of seat when checking guide.

Clearance between new components:

Intake: ..... **mm 0.03-0.06**

Exhaust: ..... **mm 0.04-0.07**

Max. clearance, used components:

Intake/exhaust: ..... **mm 0.15**

146 009

G7

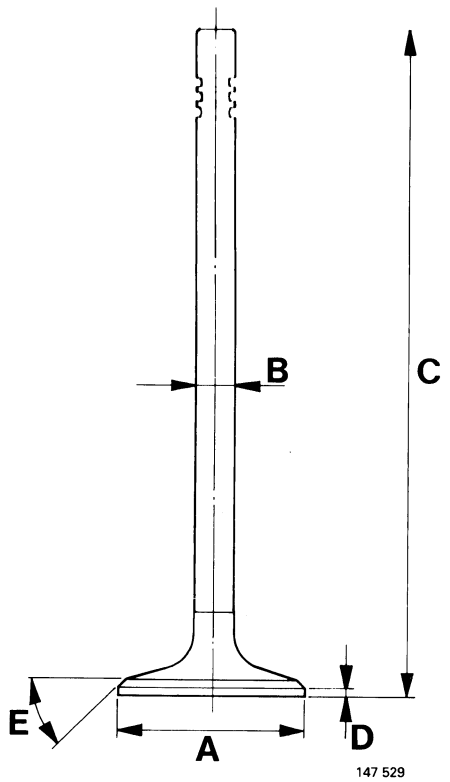
Measure valve springs

Measure spring load using tester 999 **9802.**

External diameter: ..... **mm 26.2**

Internal diameter: ..... **mm 18.1**

Length (mm)		**Load** (N)
L:	42.0	0
L1:	34.0	270±20
L2:	24.5	640±40



147 529

G8

Valves, measurement

A. Valve head diameter

Intake ..... **mm 31.00**±0.15

Exhaust ..... **mm 27.00**±0.15

B. Valve stem diameter

Intake ..... **mm** $6.97^{+0}_{-0.015}$

Exhaust ..... **mm** $6.97^{+0}_{-0.015}$

C. Overall length

Intake ..... **mm 104.05**±0.18

Exhaust ..... **mm 103.30**±0.18

Max. machining allowance, valve stem ..... **mm 0.4**

D. Height of valve head

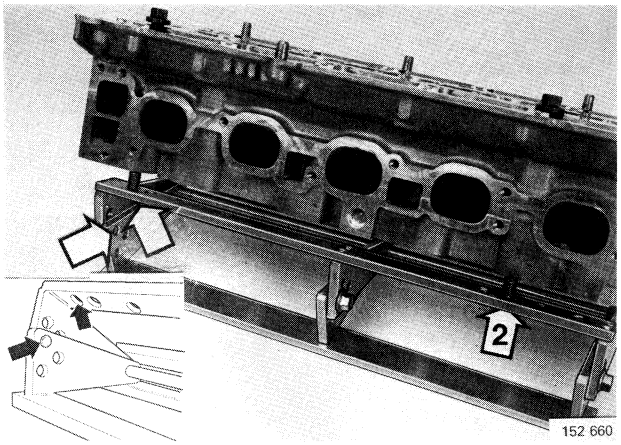
Intake/exhaust ..... **mm 1.5**

Min. height after grinding ..... **mm 1.2**

E. Sealing face angle

Intake ..... **44.5°**

Exhaust ..... **44.5°**



Valve guides, replacement

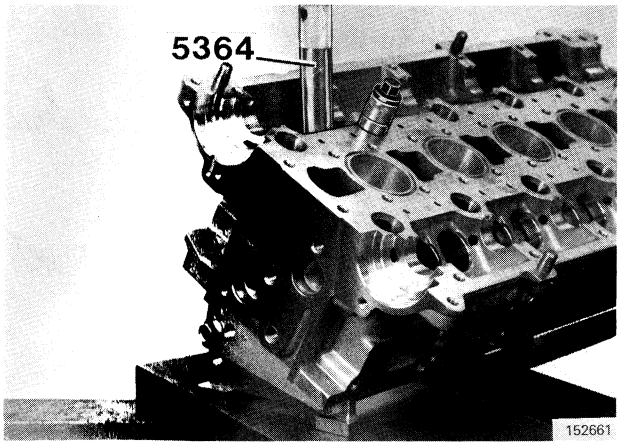
G9

Mount cylinder head on fixture 999 5363

Adjust angle of inclinations using holes at top of fixture ends.

Clamp head to fixture using any of the holes so that the drift is vertical when pressed in.

Use four sleeves as spacers for cylinder head bolts.



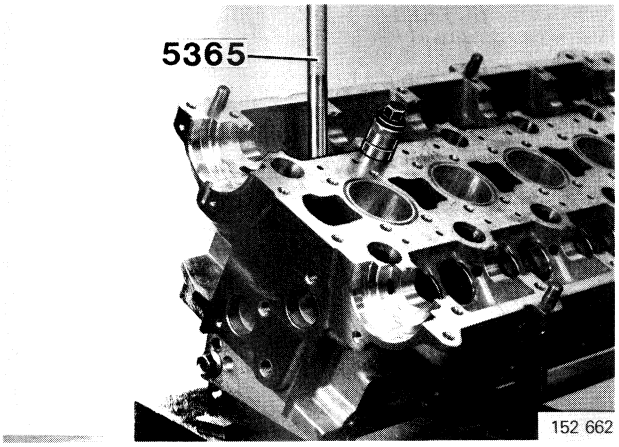
Press out guides to be replaced

G10

1. Press out guides using drift 999 5364

Press slowly until drift bears against valve spring seat.

Remove any metal clips if guide is damaged.

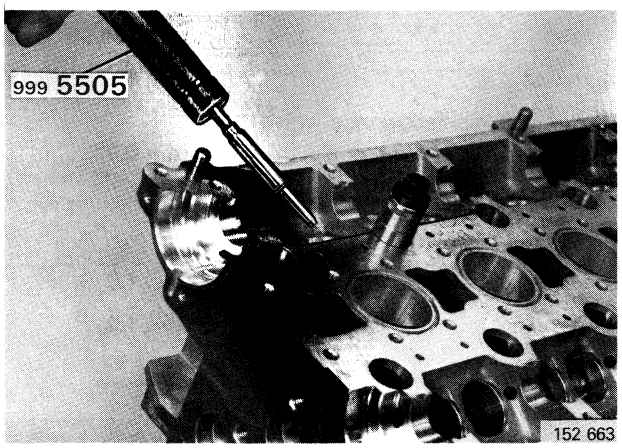


G11

2. Press down further using drift 999 5365

Inspect upper section of guide bore.

Oversize guide **must** be installed if guide bore is scored. See step **G14.**



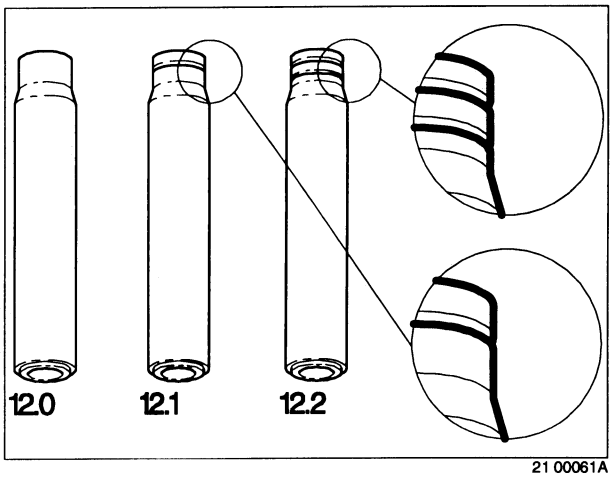
G12

3. Place new valve guide on drift 999 5505 and press home

Press guide **slowly** into head until drift bears against valve spring seat.

Top of guide should project by: ..... **mm 13**±0.2
Height is set by tool.

> **Important:** Pressure should be at least **9000 N.** If less force is required, remove guide, ream out bore and install oversize guide.

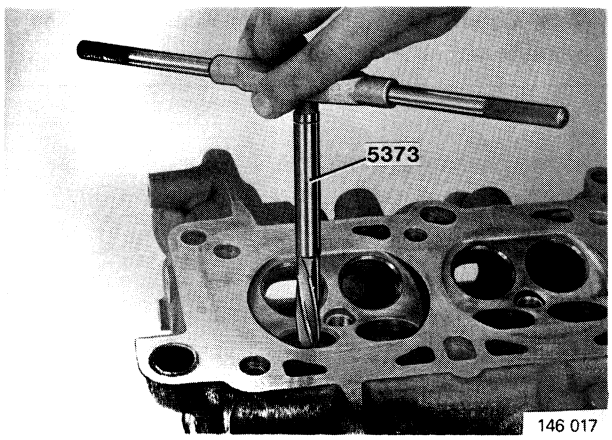


21 00061A

G13

Valve guides, markings and dimensions

Dimension type	Diameter mm	No. of grooves	P/N
Standard	12.0	0	9135628-7
Oversize, no. 1	12.1	1	9135630-3
Oversize, no. 2	12.2	2	9135631-1



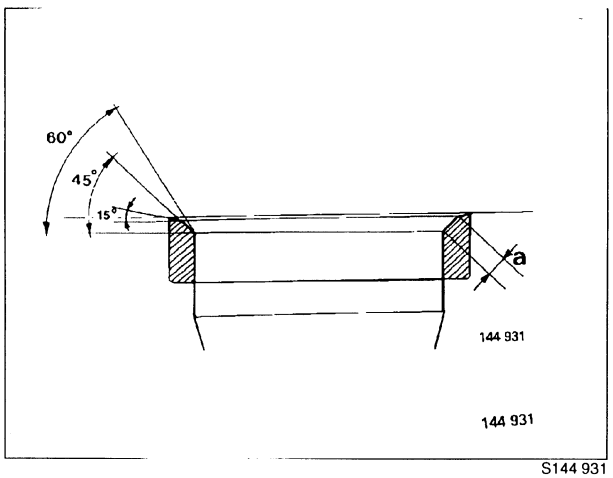
146 017

G14

To install oversize guide, ream out hole with reamer 999 5373

Note: Reamers come in two sizes (oversize 1 and 2). Oversize no. 1 can often be pressed home without reaming. See 'pressure'.

Dressing valve seats



S144 931

G15

Mill valve seats

Angles:

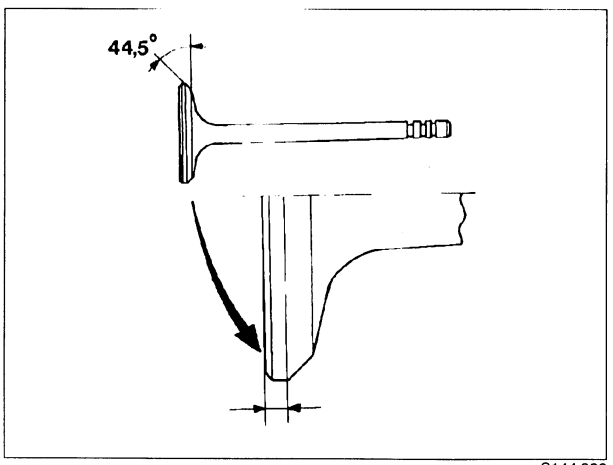
Sealing face angle, intake/exhaust: .... **45°**
Relief angle, upper: ..... **15°**
Relief angle, lower: ..... **60°**

Valve seat width: a

Intake ..... **mm 1.4-1.8**
Exhaust ..... **mm 1.8-2.2**

Note: Check that milling cutter is clear of combustion chamber walls.

Dressing valves



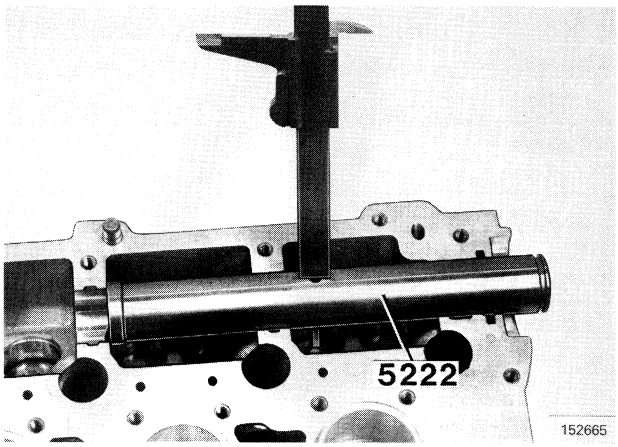
S144 932

G16

Grind intake valves

Seating face angle: ..... **44.5°**
Edge width, new valve: ..... **mm 1.5**
Min. edge width after grinding: ..... **mm 1.2**

Important: Exhaust valves are stellite coated and must be ground only with grinding paste (by hand).



G17

Check valve stem height

Use gauge 999 **5222.**

Place gauge across camshaft bearing seats.

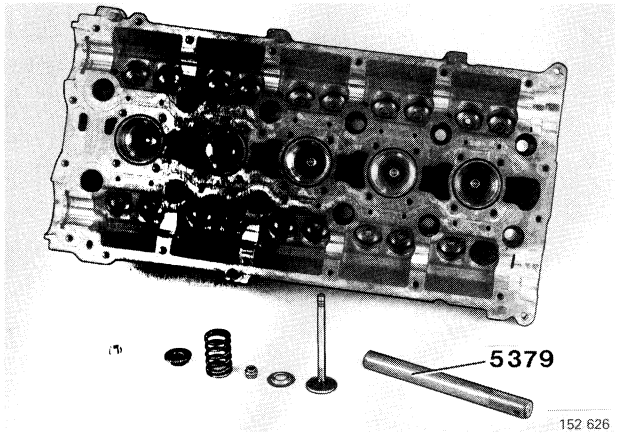
Measure valve stem height by inserting sliding calipers through hole in gauge.

Valve stem height: . . . . . **mm 48.5** ±0.4
Max. machining allowance, valve stem: . . . . . **mm 0.4**

Length, new valve

Intake: . . . . . **mm 104.5**±0.18
Exhaust: . . . . . **mm 103.3**±0.18

Note: Correct valve stem **height** is essential if the hydraulic tappets are to work properly.



Valves, installation

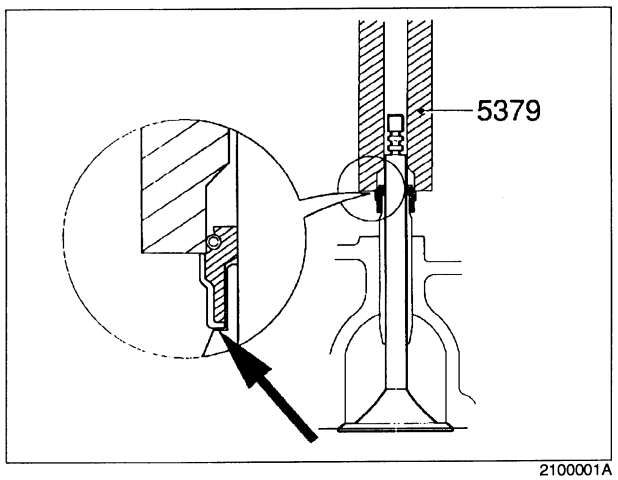
G18

Grease valve stems and guides.

Install valves

– lower valve spring collars
– valves (in correct positions)

Mount protective sleeve (included in gasket kit) on valve stem.



G19

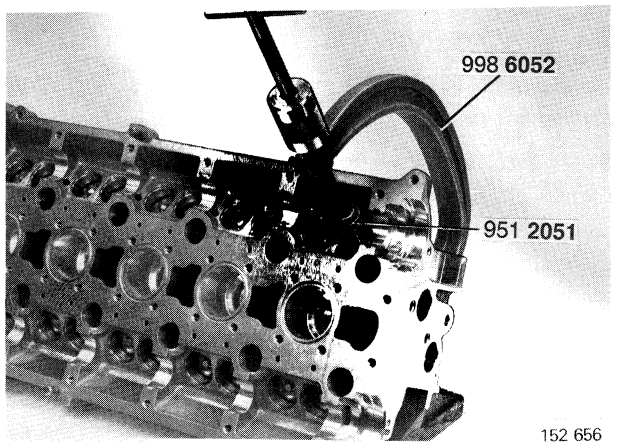
Install valve stem seals

Place seal on valve stem.

Remove protective sleeve.

Push seal onto stem **by hand only** as far as possible. Use drift 999 **5379**.

Caution: Do **not** use a hammer to fit valve stem seals, otherwise damage may result.



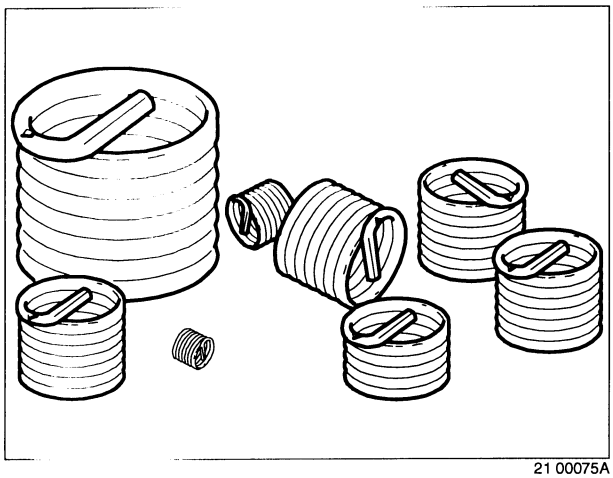
G20

Install:

– valve spring and upper spring collar using clamp 998 **6052** and clamp 951 **2051**.
– collets: check that both halves are properly in position when the spring is not under load.

H. Threads, repair

Repairs to internal threads in the cylinder block, intermediate section and cylinder head are carried out with the aid of thread inserts. Some threaded holes cannot be repaired in this way because the threads are too fine. (Holes which should not be repaired are also included in the tables below.)



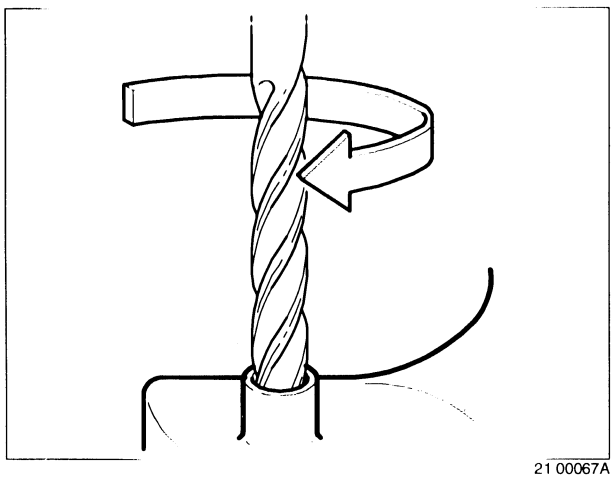
21 00075A

Thread inserts

Thread inserts are made of cold-rolled wire sectioned to ISO thread standards. The material used is stainless, acid-resistant steel. Inserts are designed to be fitted in holes which are drilled and threaded as per the standard thread insert tables.

Thread inserts have a handle with breaking instructions. This handle must be knocked off after installation.

Procedure:



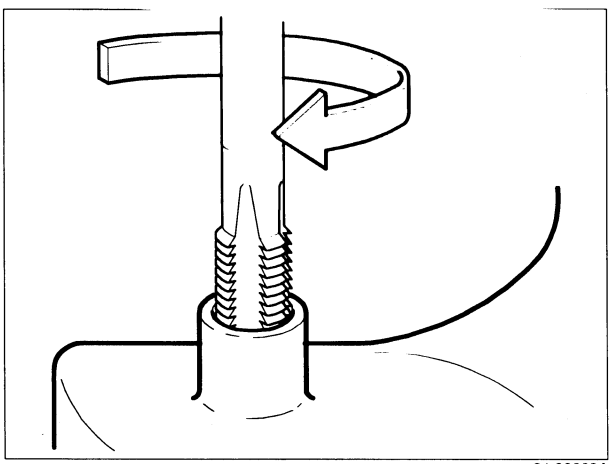
21 00067A

H1

Drill out the hole to be repaired

Use a drill diameter and length taken from the thread insert tables on pages 43, 46 and 48.

Do **not** lower the edges of holes; we recommend only a slight angling.



21 00068A

H2

Thread the hole using the die for the thread insert

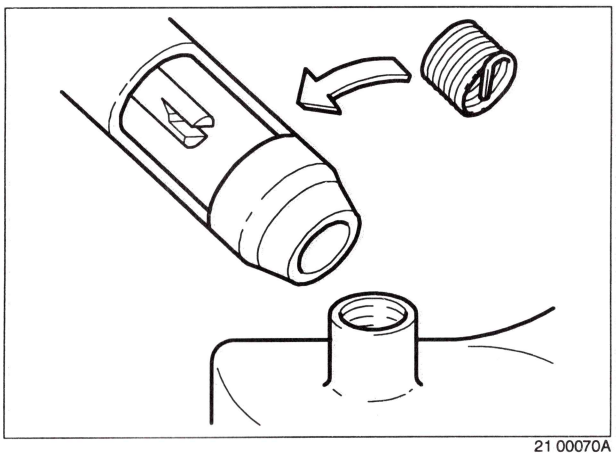
Use the right die for the material and work concerned.

When working on an M10 threaded hole, use a die for an **M10 thread insert.**

Thread down to the right depth (see table).

Blow hole clean.

Use correct length thread insert (see table).

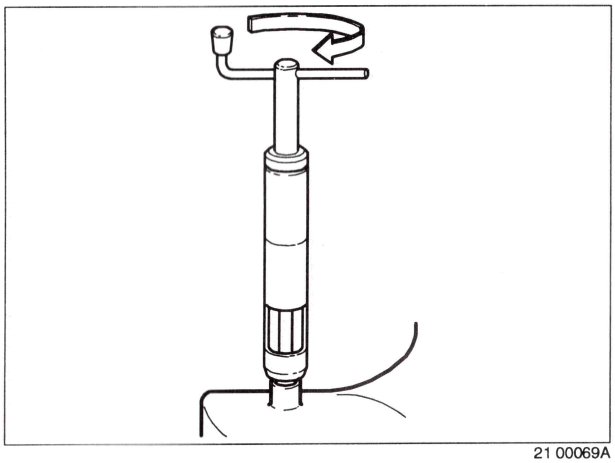


21 00070A

H3

Insert thread insert in fitting tool

Insert the insert with the handle downwards.



21 00069A

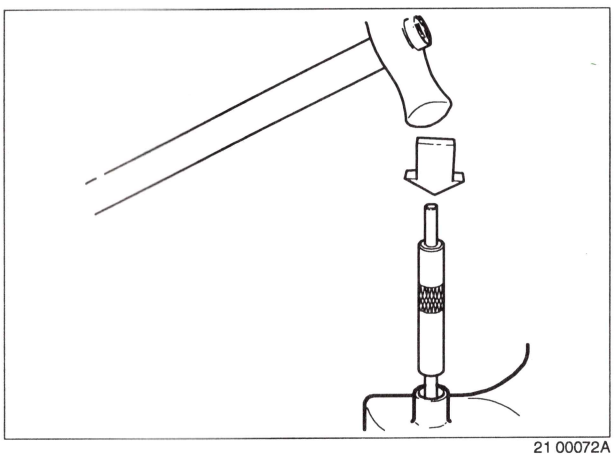
H4

Install thread insert

Hold fitting tool immediately over the threaded hole.

Wind thread insert in until approximately one complete turn remains projected out of the hole.

If a hole goes right through, the thread insert must not project out of the bottom of the hole.



21 00072A

H5

Knock off fitting pin

Knock handle off with pin hammer. Do **not** use the fitting tool to knock the handle off.

Remove handle and blow hole clean.

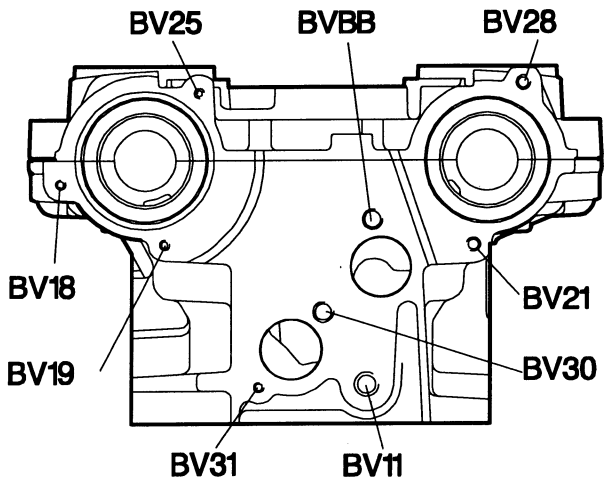
Using a bolt, check that the thread is clear and that the thread insert is installed correctly.

Repairs to cylinder head and camshaft casing

The table below shows which holes in the cylinder head and camshaft casing can be repaired and which thread inserts to use.

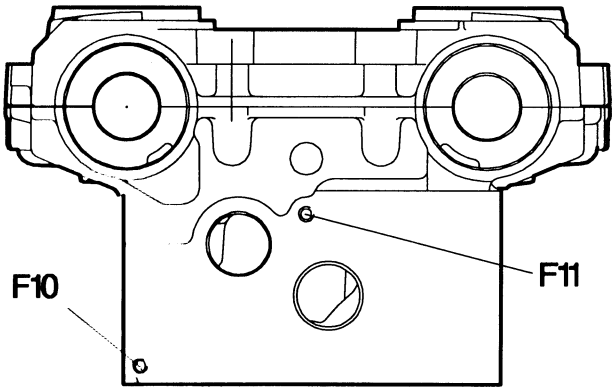
The table also shows drilling depth and diameter and the part numbers for each thread insert.

Existing threads		**For repairs use thread inserts**						**Use**	**Holes as shown in diagrams on pages 44 and 45**
Qty	Thread dim.	Thread dim.	Length mm	P/N thread insert	Drill diam. mm	Drilling depth mm	Min. thread depth mm		
1	M12-6H	M12×1.75	12	956026-9	12.5	24	12	Engine coolant temp sensor	BV11
3	M5-6H	M5×0.8	10	956011-1	5.3	15	10	Distributor	BV18, BV19, BV25
2	M7-6H7H	M7×1	17.5	947845-4	7.4	21.5	17.5	Camshaft pos. sensor	BV21, BV28
2	M10-6H	M10×1.5	20	956023-6	10.4	28	20	Lifting lug	BV30, BVBB
1	M5-6H	M5×0.8	10	956011-1	5.3	15	10	Ground bolt	BV31
3	M7-6H7H	M7×1	17.5	947845-4	7.4	21.5	17.5	Thermostat housing	V14-16
9	M7-6H7H	M7×1	17.5	947845-4	7.4	21.5	17.5	Intake manifold	V17-25
2	M7-6H7H	M7×1	17.5	947845-4	7.4	21.5	17.5	Timing belt cover rear	F10-11
2	M7-6H7H	M7×1	17.5	947845-4	7.4	21.5	17.5	Bypass pipe	H13-14
12	M8-6H7H	M8×1.25	16	965158-9	8.4	24	16	Exhaust manifold	H15-H26
2	M6-6H7H	M6×1	9	956014-5	6.3	16	9	Timing belt cover, upper	TT1-2
12	M6-6H7H	M6×1	9	956014-5	6.3	16	9	Ignition coils	T115-126
6	M6-6H7H	M6×1	9	956014-5	6.3	16	9	Sparkplug cover	T133-136, T139-140
46	M7-6H7H	M7×1	17.5	947845-4	7.4	16	17.5	Camshaft casing	T29-34, T36, T38-73, T75, T77-78



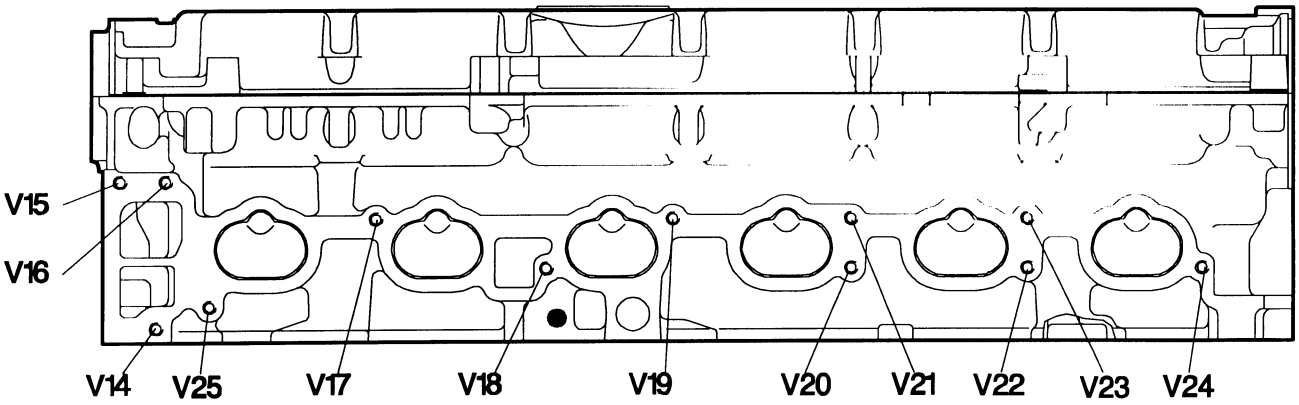
Rear view

21 00084A



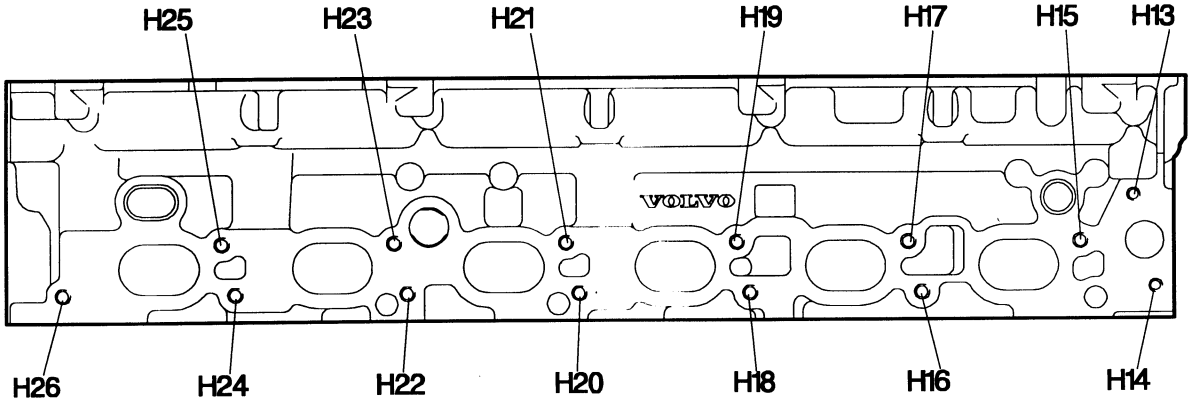
Front view

21 00085A



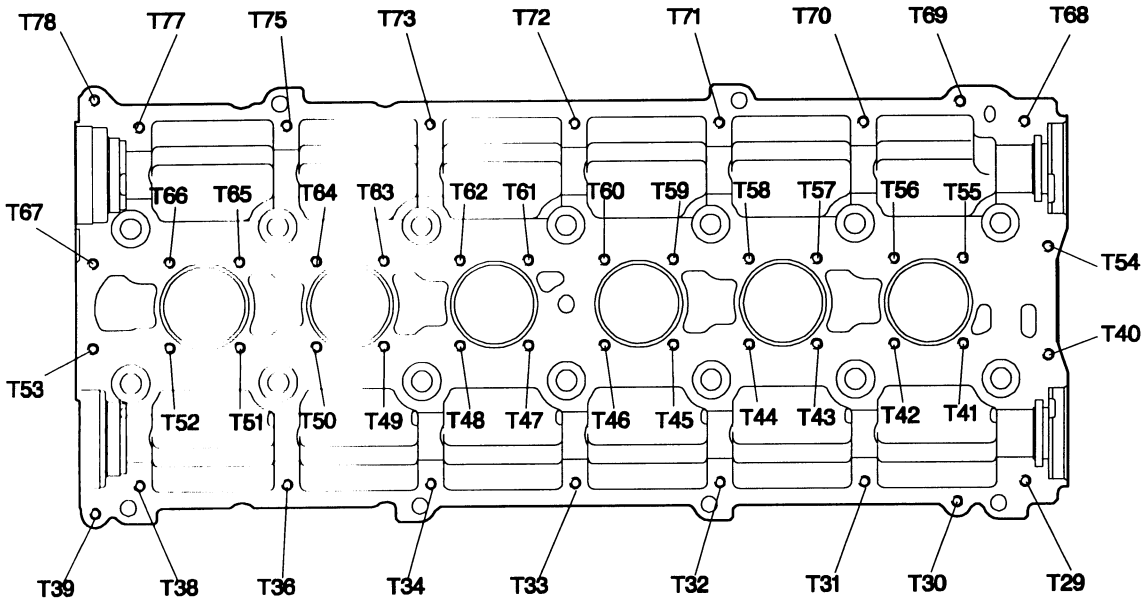
21 00086A

LH view



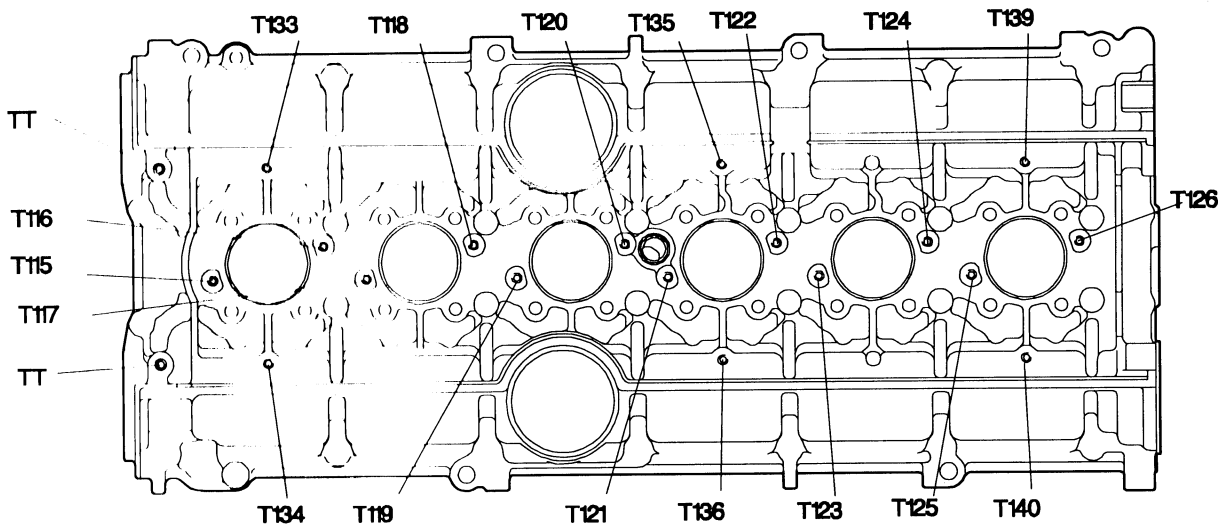
RH view cylinder head

21 00087A



Top view, cylinder head

21 00088A



Top view camshaft casing

21 00089A

H7

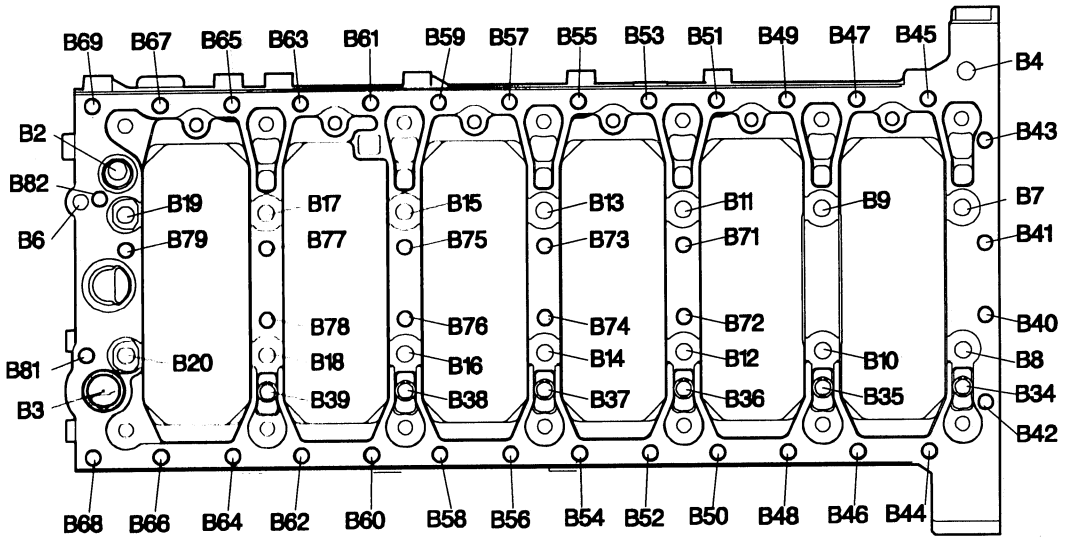
Repairs to cylinder block and intermediate section

The table below (contd. on page 48) shows which threaded holes on the cylinder block (CB) and intermediate section (IS) can be repaired and which thread inserts to use.

The table also shows drilling depth and drill diameter and the part numbers for the respective thread inserts.

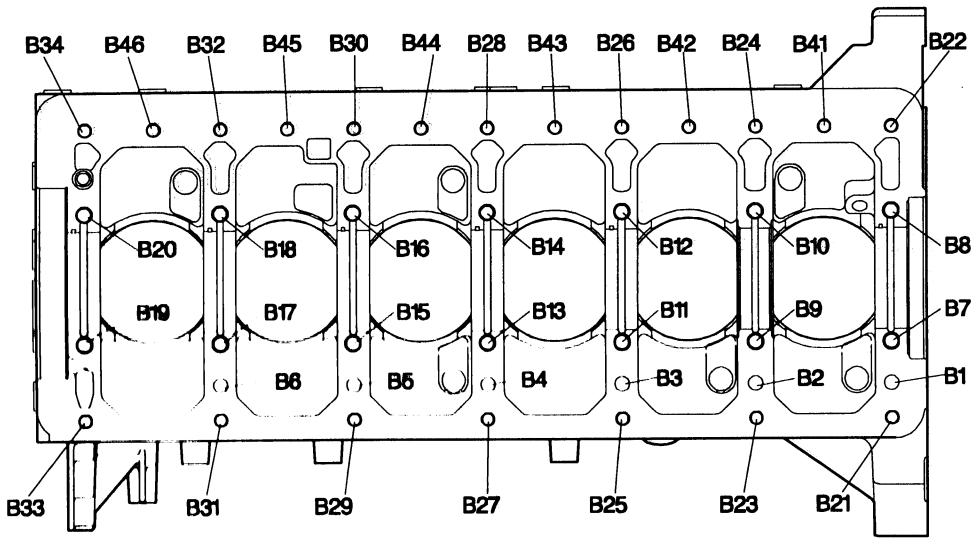
> **Note:** Do not repair holes marked **V3** with thread inserts.

Existing threads		**Can be repaired with thread inserts**						**Use**	**Holes as marked on diagrams on page 47**
Qty	Thread dim.	Thread dim.	Length mm	P/N thread insert	Drill diam. mm	Drill depth mm	Min. thread depth mm		
33	M7-6H7H	M7×1	14	941843-5	7.3	18	14	Oil sump	B40-69, B79, B81-82
2	M7-6H7H	M7×1	14	941843-5	7.3	18	14	Oil sump pipe	B71, B78
14	M10-6H8H	M10×1.5	25	956024-4	10.5	33	25	Intermediate section, bearing shells	B7-20
14	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Intermediate section	B21-34
6	M7-6H7H	M7×1	14	941843-5	7.3	18	14	Intermediate section	B41-46
1	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Starter motor	V10
4	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Engine mounting	V11-12, V35-36
6	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Auxiliaries	V21-22, V26-27, V31-32
2	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Knock sensor	V37-38
1	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Oil dipstick	V16
3	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	EGR valve	V17-19
3	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Electrical ground	V15, V33-34
1	M16	**Must not be repaired**						Crankshaft setting	V3
1	M14	M14×1.5	20	967576-0	14.2	24	21	Oil pressure switch	V4
2	M7-6H7H	M7×1	14	941843-5	7.3	18	14	Oil trap	V40, V41 P/N (bolt): 977636



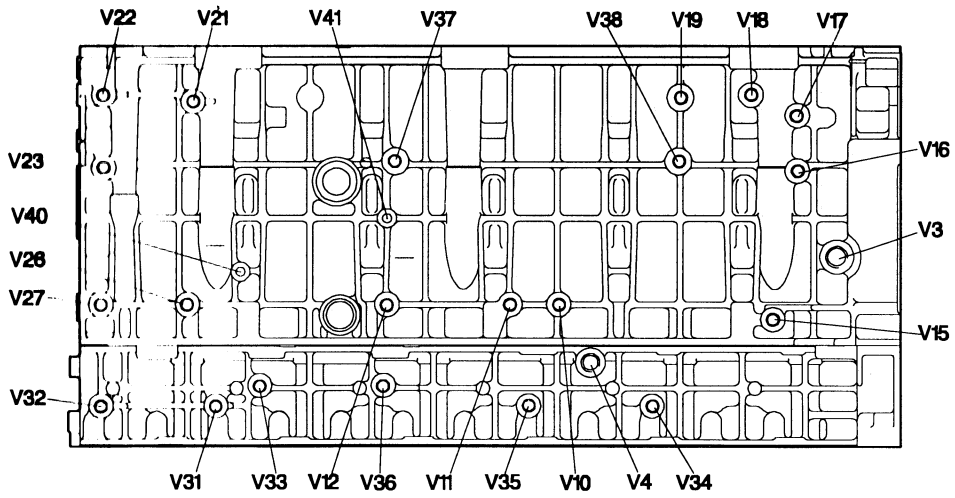
21 00082A

Underside view, intermediate section



21 00083A

Underside view, cylinder block



21 00081A

LH side, cylinder block and intermediate section

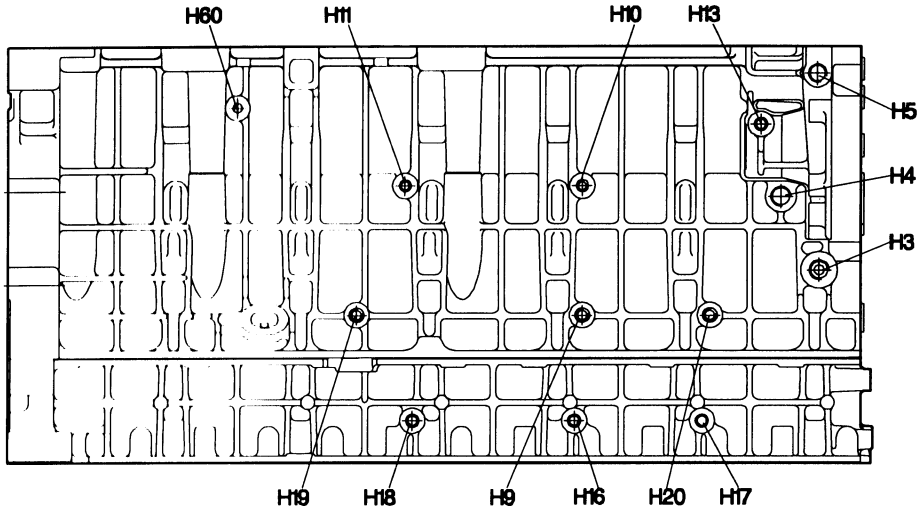
Further repairs, cylinder block and intermediate section

The table below (continued from page 46) shows which threaded holes in the cylinder block (CB) and intermediate section (IS) can be repaired and which thread inserts to use. It also shows the drilling depth, drill diameter and part number for each thread insert.

Note: Holes marked **H4**, **H5**, **BV3**, **BV5**, **BV10** and **BV21** must not be repaired using thread inserts.

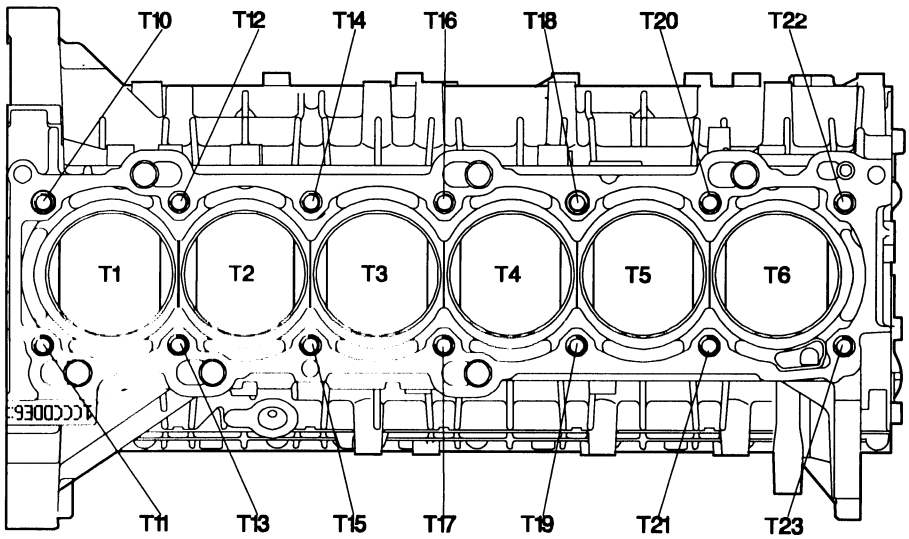
Existing threads		**Can be repaired with thread inserts**						**Use**	**Holes marked as shown in diagrams on page 49**
Qty	Thread dim.	Thread dim.	Length mm	P/N thread insert	Drill diam. mm	Drilling depth mm	Min. thread depth mm		
4	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Engine mounting	H9, N16, H18, H19
2	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Turbo stage	H10, H11
2	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Electrical ground	H17, H20
1	M14	M14×1.5	20	967576-0	14.2	24	21	Turbo oil pressure	H3
1	1/4″	**Must not be repaired**						Coolant drain	H4
1	1/4″	**Must not be repaired**						Parking heater	H5
1	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Coolant pipe	H13
14	M12-6H8H	M12×1.75	24	956028-5	12.5	34	24	Cylinder block	T10-23
1	M7-6H7H	M7×1	14	941843-5	7.3	18	14	Timing belt cover	F16
2	M7-6H7H	M7×1	14	941843-5	7.3	18	14	These holes omitted	F15, F17
3	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Engine mounting	(F11-13) *
5	M8-6H7H	M8×1.25	16	956019-4	8.4	24	16	Timing belt tensioner	F10, F14, F25, F26, F28
7	M7-6H7H	M7×1	14	941843-5	7.3	18	14	Coolant pump	F18-24
4	M7-6H7H	M6×1	12	956015-2	6.3	19	12	Oil pump	F30-33
3	M12	**Must not be repaired**						Mounting bracket VPK (gearbox)	BV3, BV5, BV10
3	M10-6H8H	M10×1.5	20	956023-6	10.5	28	20	Gearbox	BV4, BV6, BV7
2	M10-6H8H	M10×1.5	20	956023-6	10.5	28	20	Torque arm	(BV8, BV9) *
2	M7-6H7H	M7×1	10.5	948015-3	7.3	14.5	10.5	RPM sensor	BV15, BV16
1	3/8″	**Must not be repaired**						Passenger compartment heater	BV21
1	M7-6H7H	M7×1	14	941843-5	7.3	18	14	Coolant pump intake pipe	H60 P/N (bolt): 968814

*) 5-cylinder engines only



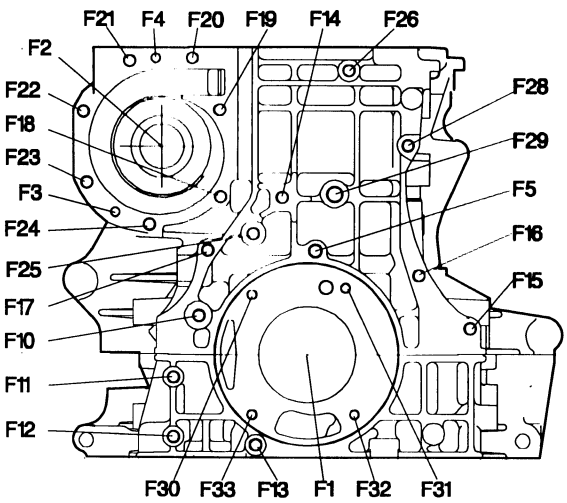
RH side, cylinder and intermediate section

21 00077A



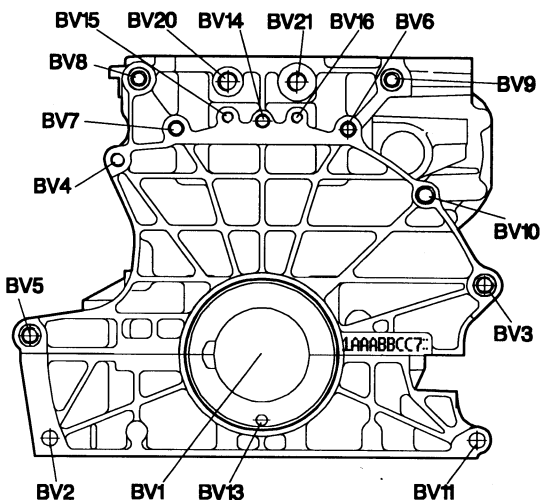
21 00078A

Top view, cylinder block



Front view, cylinder block and intermediate section

21 00079A



Rear view, cylinder block and intermediate section

21 00080A

I. Hermetically sealed bolts, sealing

Hermetically sealed bolts are used where a perfect seal is required. Replace bolts once undone or seal with new sealing compound. HYDRAULIC THREAD SEALING COMPOUND part number is **11 61 056-5**; follow instructions on pack. This service bulletin includes a list and illustrations of hermetically sealed bolts on the B6304 engine.

I1

2100121S

Sealing compound

Hydraulic thread sealing compound

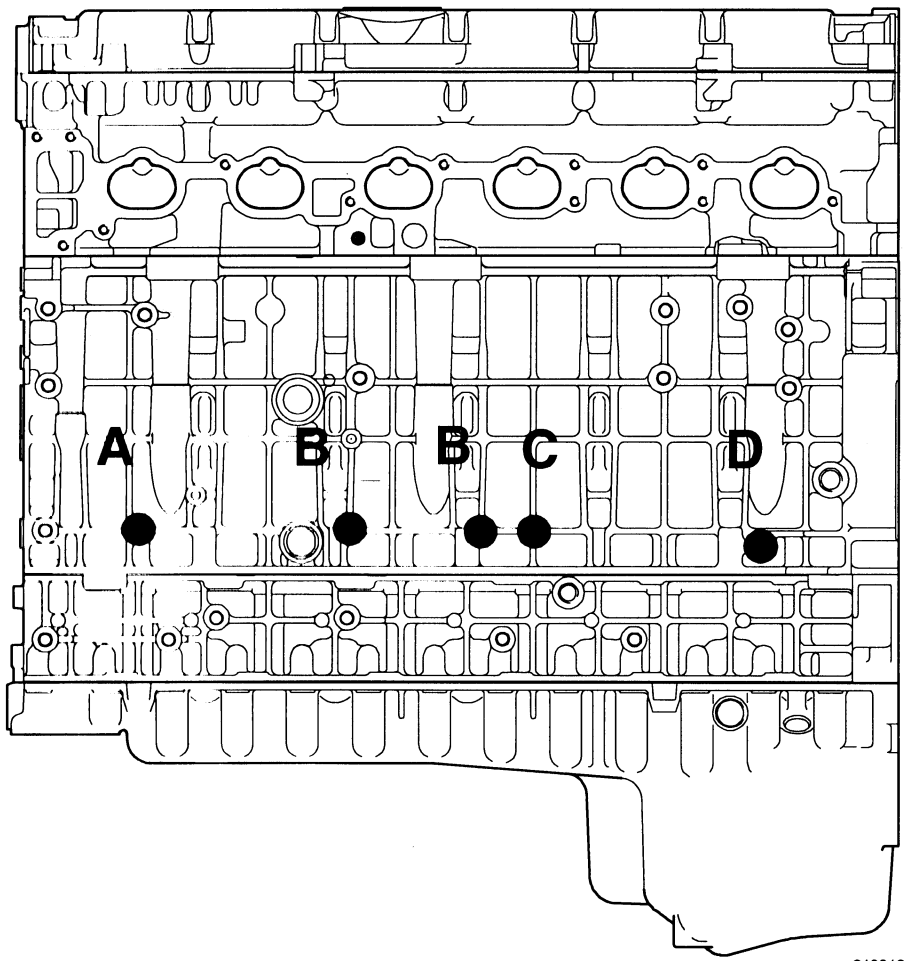
- P/N 11 61 056-5
- Apply sealing compound to bolts using brush or pipe on pack.
- Avoid sealing compound coming into contact with skin.

Bolts to be sealed with HYDRAULIC THREAD SEALING COMPOUND.

I2

Engine intake side

Position	Description	Qty.	P/N
A	Auxiliaries bracket bolt	1	946671-5
B	Engine mounting bolt	1	948217-5
B	Engine mounting bolt	1	948217-5
C	Starter motor mounting bolt	1	946440-5
D	Cable mounting bolt	1	946173-2



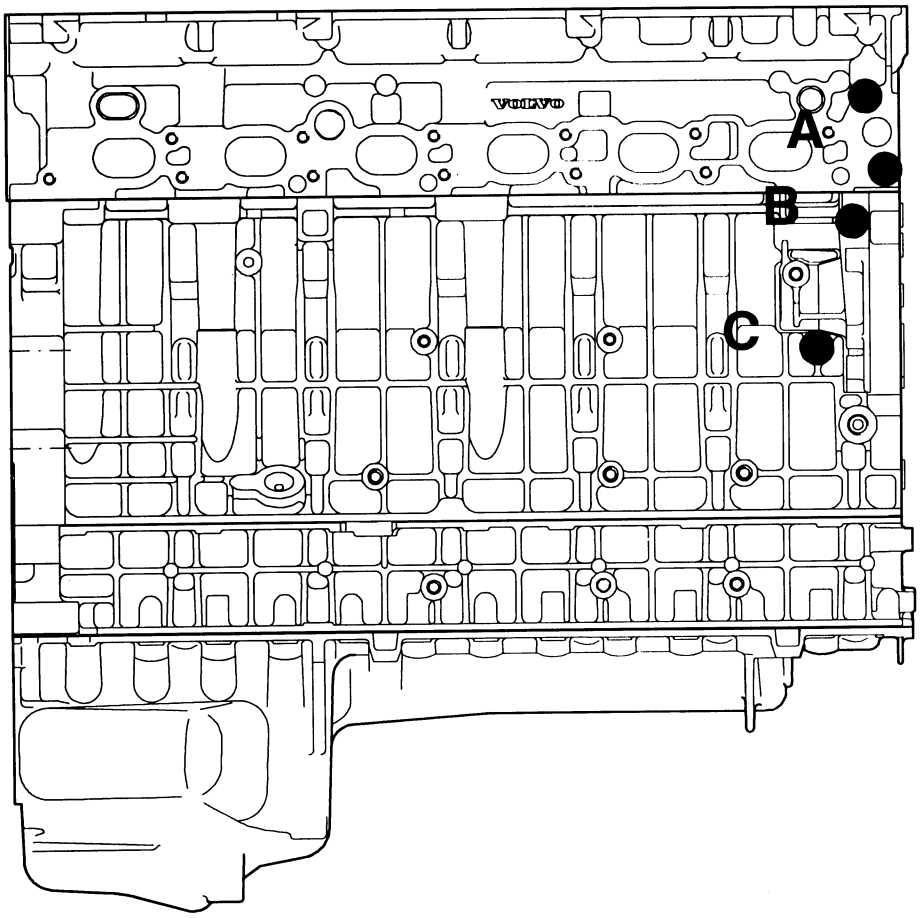
2100121A

Bolts to be tightened with HYDRAULIC THREAD SEAL COMPOUND.

I3

Engine exhaust side

Position	Description	Qty.	P/N
A	Coolant pipe bolt	2	975880-6
B	Coolant pump casing plug	1	968144-6
C	Drain plug	1	9135268-2



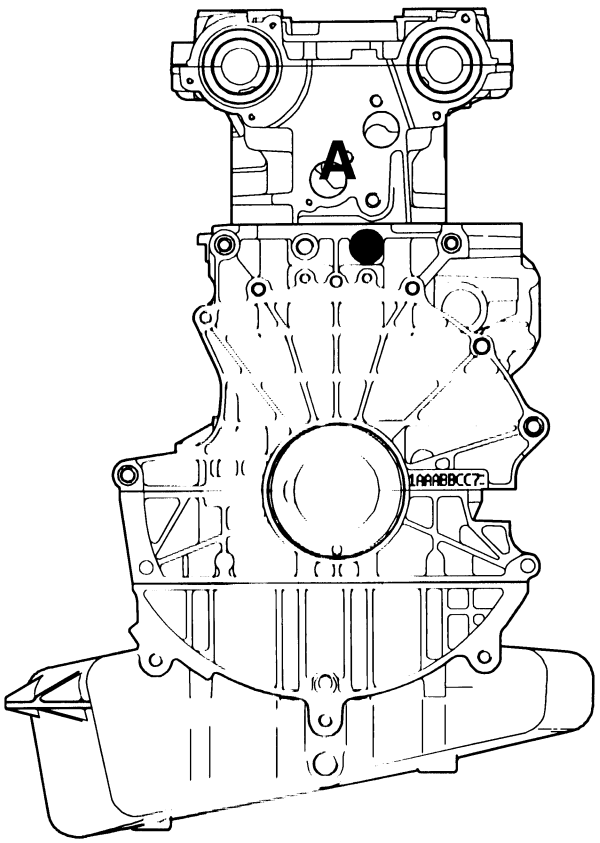
2100122A

Bolts to be tightened with HYDRAULIC THREAD SEALING COMPOUND.

I4

Engine rear

	Description	Qty.	P/N
A	Nipple bolt	1	1397915-8

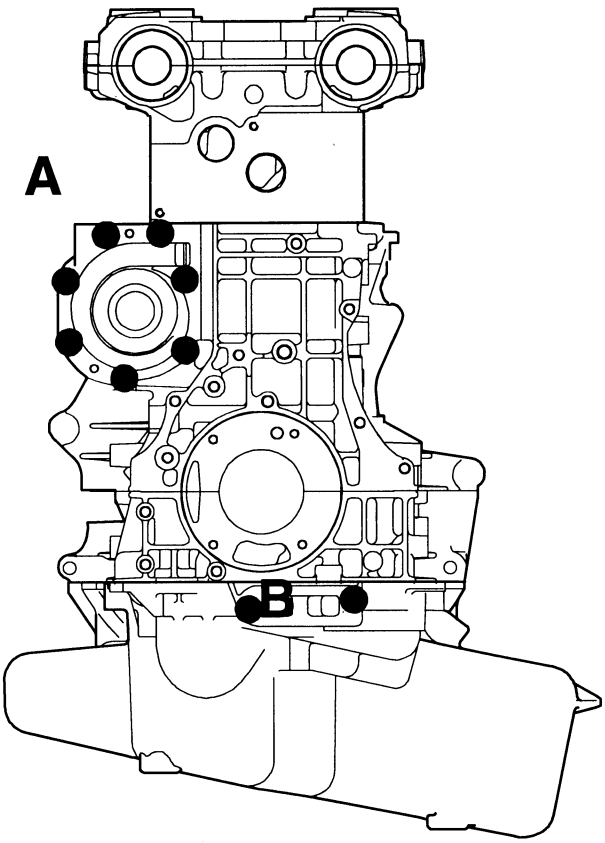


2100122A

I5

Engine front

	Description	Qty.	P/N
A	Coolant pump bolt	7	977744-2
B	Oil thermostat housing bolt	2	975883-0

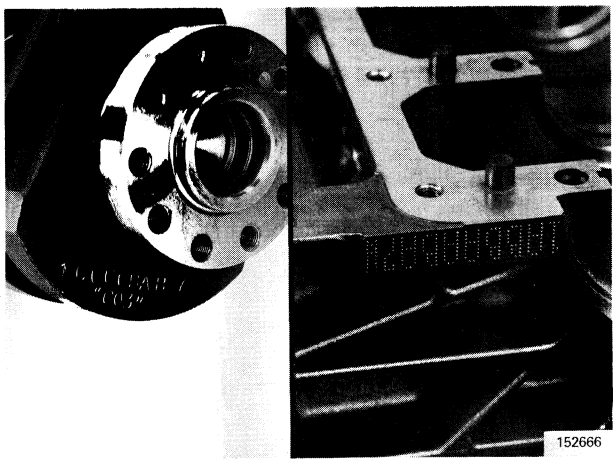


2100122A

J. Crank mechanism, reassembly

Special tools: 999 1801, -5430, -5502, -5971, -9696

Universal tools: 115 8281, 951 1205, 998 5424


152666

J1

Classification of crankshaft main bearings

Clean main bearing seats.

Check that components are clean and undamaged.

Check classification on cylinder block and crankshaft.

Each main bearing seat is marked with the cylinder number and a classification letter for the block and crankshaft. Use the table below to select the right bearing.

Block classification

Crankshaft classification	A small diameter		B medium diameter		C large diameter	
	block	int. sect.	block	int. sect.	block	int. sect.
A small	yellow medium	yellow medium	yellow medium	blue thick	blue thick	blue thick
B medium	red thin	yellow medium	yellow medium	yellow medium	yellow medium	blue thick
C large	red thin	red thin	red thin	yellow medium	yellow medium	yellow medium

J2

Selecting bearing

Install main bearing in cylinder block as in table.

Oil bearing shells liberally on crankshaft side.

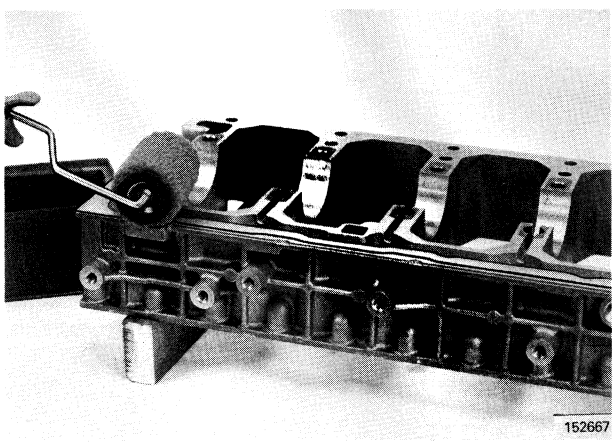
Install flanged shells in rearmost position.

E.g.: Classifying no. 1 bearing.

*Marking on block is **B**.*

*Marking on crankshaft is **C**.*

*Install a **red** bearing in the block and a **yellow** bearing in the intermediate section.*


152667

J3

Intermediate section

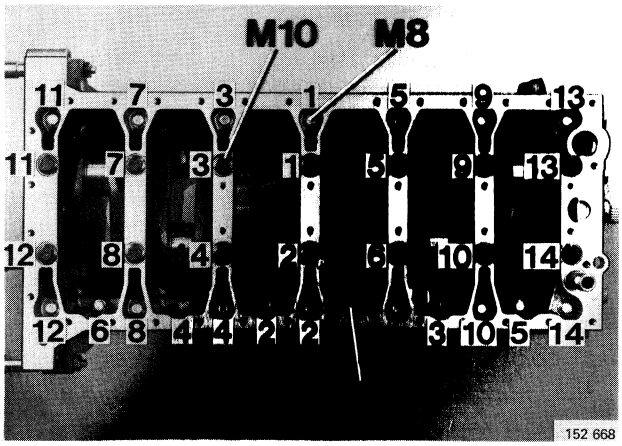
Apply liquid sealing compound (1 161 059-9) to intermediate section. Cover entire surface, but do not allow to overflow, as this may block ducts and bolt holes.

Use short-haired roller 951 **1205**.

Place bearing shells in intermediate section (make sure bearing shells are dry between bearing and block. otherwise bearing may rotate along with crankshaft).

Oil bearing shells and flange bearing (furthest back) generously.

J4



Install crankshaft

Install crankshaft. Do **not** turn crankshaft before intermediate section has been tightened.

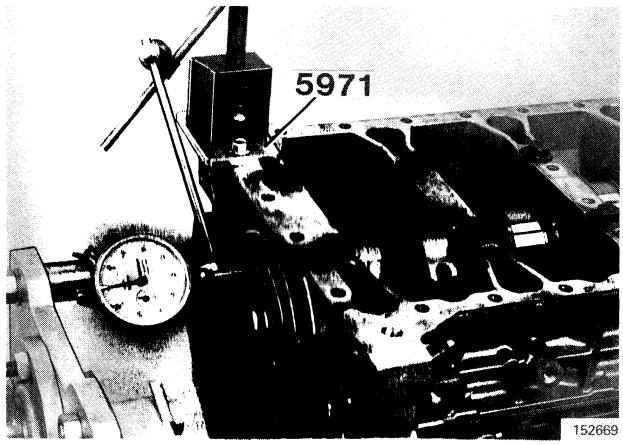
Put intermediate section in position.

Tighten intermediate section/crankshaft bolts in five stages in numerical order as shown in picture. Each stage must be complete before starting the next.

1. Tighten all M10 bolts to ..... **20 Nm** (15 ftlb)
   (skip M8 and M7 until stages 3 and 4.)
2. Tighten M10 bolts to ..... **45 Nm** (33 ftlb)
3. Tighten M8 bolts to ..... **24 Nm** (18 ftlb)
4. Tighten M7 bolts to ..... **17 Nm** (13 ftlb)
5. Finally, tighten M10 bolts ..... **90°**

Max. length of M10 bolts: . . . . . mm 118

J5



Measure crankshaft end float

Check that crankshaft turns smoothly.

Measure end float.

Use dial gauge, magnetic plate 999 **5971** and magnetic stand 999 **9696**.

End float: ..... **mm 0.08-0.19**

J6

J 6

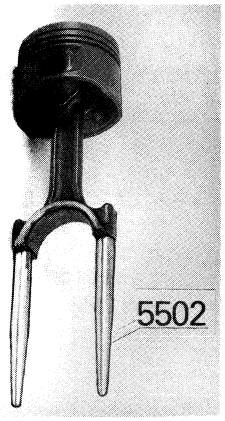
Install rear crankshaft seal

- Take out the seal and lubricate the mating surfaces of the holder and seal lips.
- Thread the bevelled section of the inner drift with the seal, the matted side facing outwards.
- Install the drift on the crankshaft.
- Tap the seal into place with the outer drift and crank 999 1801.

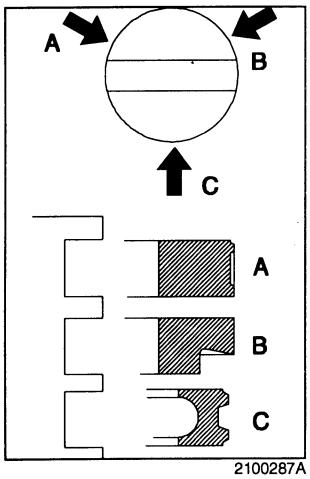
The seal is in position when the outer drift touches the bottom of the inner drift.

152671

Note: Insert circlip and check that ring springs apart and locks in groove. Circlip opening should point downwards.



S152 672



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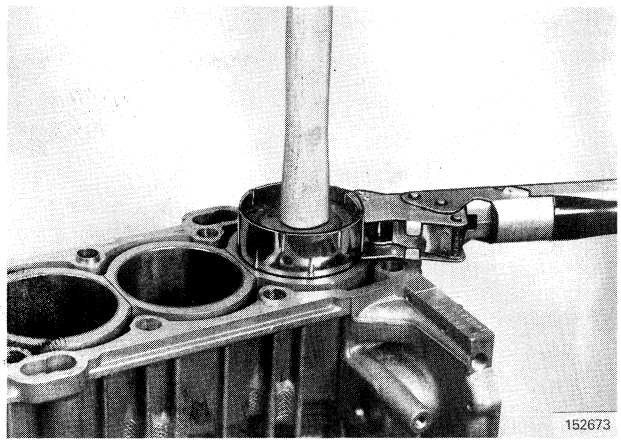


152673

J7

Assemble pistons and conrods

Arrow on piston crown must point forwards, i.e. towards timing belt end of engine. Number markings on conrods must face towards intake side of block (starter motor side).

Piston, replacement: *Later Volvo 960 models have two types of piston, which differ in terms of their upper compression rings. Version 1 can be replaced by version 2 without having to replace all pistons; but version 2 must* ***not*** *be replaced by version 1.*

Conrod, replacement: *Conrods are symmetrical and can be used either way round.*
Markings: Install conrod (tighten bolts to ***20 Nm*** *(15 ftlb)) and check that bearing cap is pointing in the right direction. Put big end in a vice with copper inserts or similar. Mark both halves with the cylinder number using a number punch or die.*

J8

Install piston rings

Use piston ring pliers 998 **5424.** Turn piston rings so gaps are approx. **120°** apart.

Piston rings, dimensions: See specifications p.6.

A. Upper compression ring: *Text facing upwards*
B. Lower compression ring: *Groove facing downwards*
C. Oil scraper ring: *Text facing upwards*

Clean and dry bearing seats in conrods and caps.

Install bearing shells in conrods and caps.

Install guide pins 999 **5502**.

Important: If reusing **original** bearing shells, components **must** be located in original positions.

J9

Install pistons in bores

Use piston ring compressor 115 **8281.**

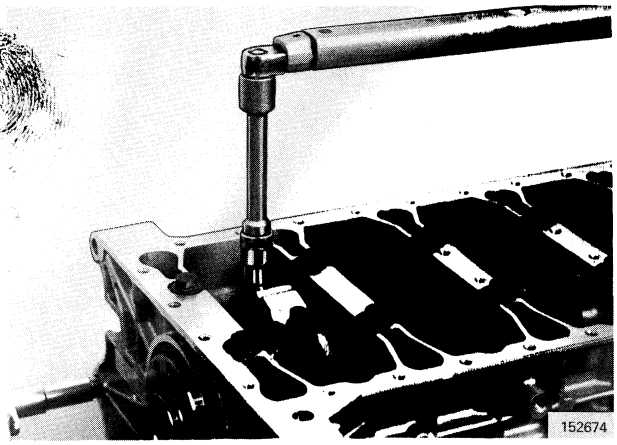
Oil cylinder bores, pistons and bearing shells.

When fitting each piston, turn crankshaft so crank pin is at its lowest position to fit the piston in.

Check that piston classification is correct.

Press piston down (e.g. with hammer shaft).

Note: Arrows on piston crown **must** point towards front, i.e. timing belt, end of engine.



J10

Install bearing caps

Remove guide pins (5502) and install caps.

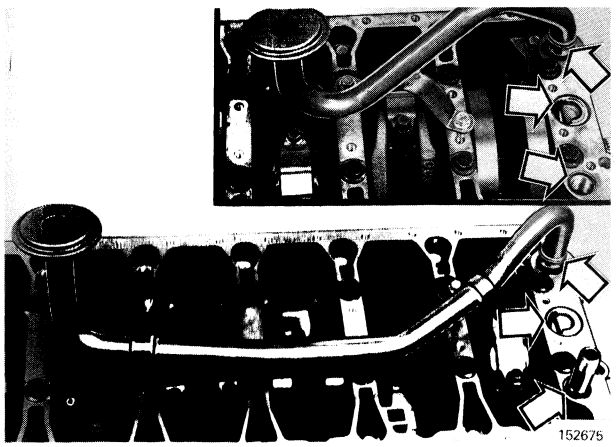
> **Note:** Do **not** turn crankshaft until conrod bearing caps have been tightened.

Check that conrod and bearing cap markings match.

Use **new** bolts. Oil bolts, and tighten in two stages:

1. **20 Nm** (15 ftlb)
2. Plus **90°**

Check that conrods are free to move laterally.



J11

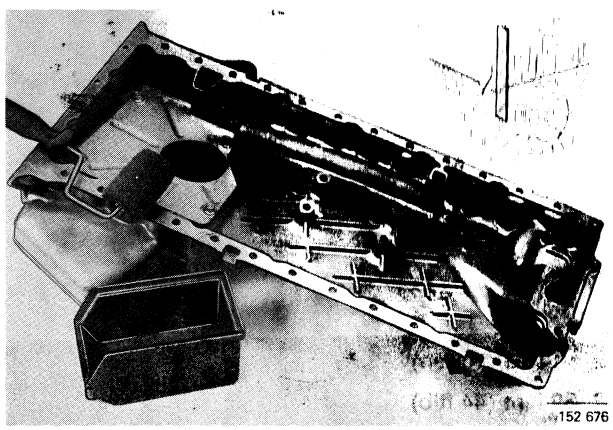
Install oil pump suction pipe

Put gasket on pipe.

Reconnect pipe.

Tighten to 17 Nm (13 ftlb).

Install **new** oil passage seals.



J12

Install oil sump

Apply liquid sealing compound (P/N 1 161 059-9) to sump. Use short-haired roller 951 **1205.**

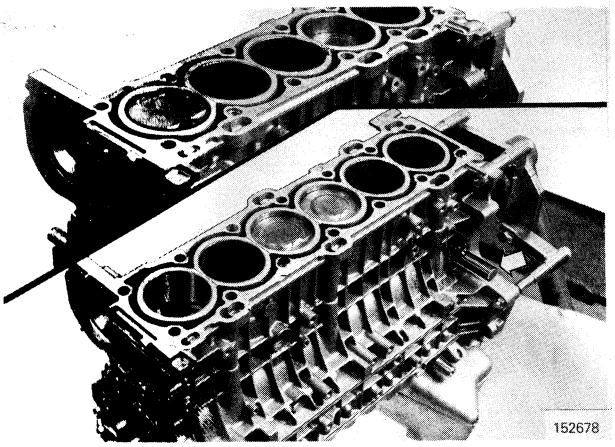
> **Important:** Insert four bolts and align sump flush with rear face of block. Permitted tolerance =±0.025 mm.

Tighten bolts back and front to **17 Nm** (13 ftlb).

Install **new** oil filter.

K. Cylinder head, installation

Special tools: 999 1801, -5449, -5451, -5452, -5453, -5454



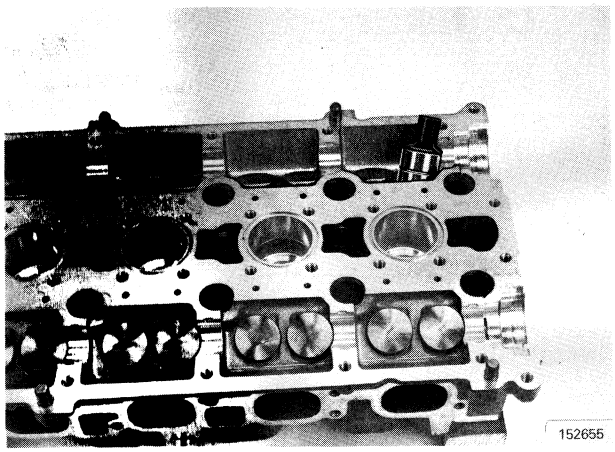
K1

Lock crankshaft in position

Use crankshaft locking tool 999 **5451** at rear of engine (see picture).

Turn crankshaft counterclockwise until counterweight meets stop.

Check that piston in last cylinder (5 or 6) is midway between TDC and BDC.

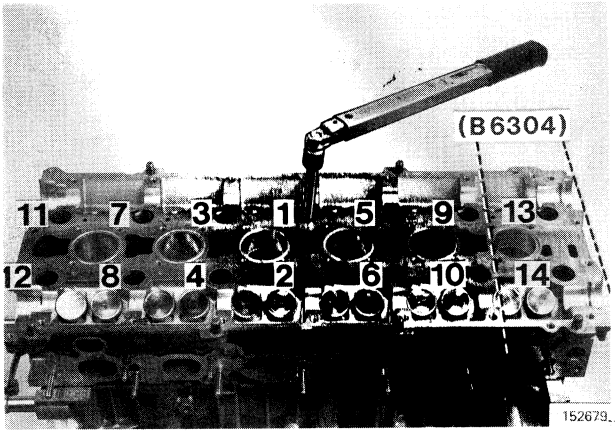


K2

Install tappets

Tappets **must** be reinstalled in original positions, and oiled

> **Note:** If tappets have leaked oil, top them up with an oilcan or similar via the hole in the side.



K3

Install lower cylinder head section

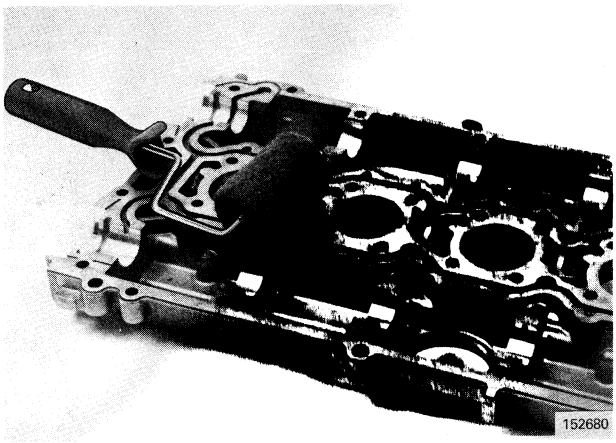
Use **new** cylinder head gasket.

Max. length of M12 bolts:	**158 mm**

Oil bolts. Tighten bolts as follows, starting from center and working outwards:

1. **20 Nm**
2. **60 Nm**
3. **130°**

Install new O-rings around sparkplug wells.

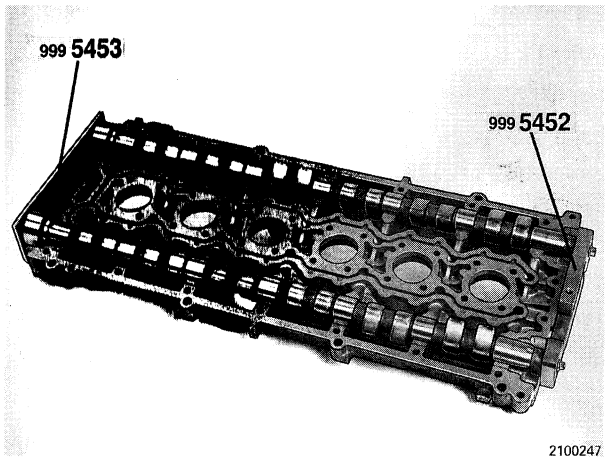


K4

Apply liquid sealing compound

Apply liquid sealing compound (1 161 059-9) to camshaft carrier, using short-haired roller 951 **1205**.

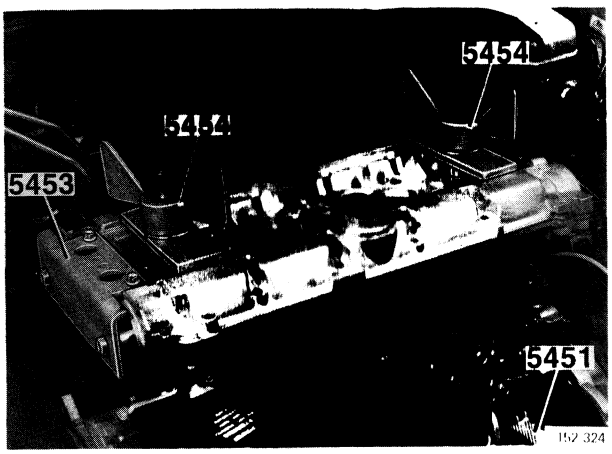
> **Note:** Make sure no sealing compound gets into coolant or oil passages.



K5

Install camshafts

Install camshafts. Fix camshafts in position using retainer 999 **5453** at front end and locating tool 999 **5452** (without extension pieces).



K6

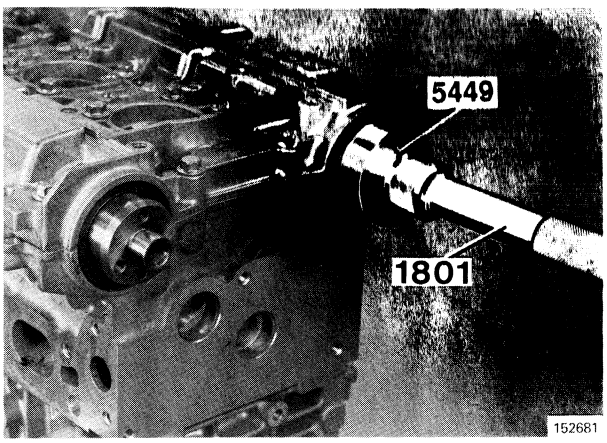
Install top cylinder head section

Place top section in position.

Tighten it against cylinder head using press tools 999 **5454** (2x).

Tighten top section from inside and out to **17 Nm** (13 ftlb).

Remove retainer (5453) and press tools (5454).



K7

Install camshaft front seals

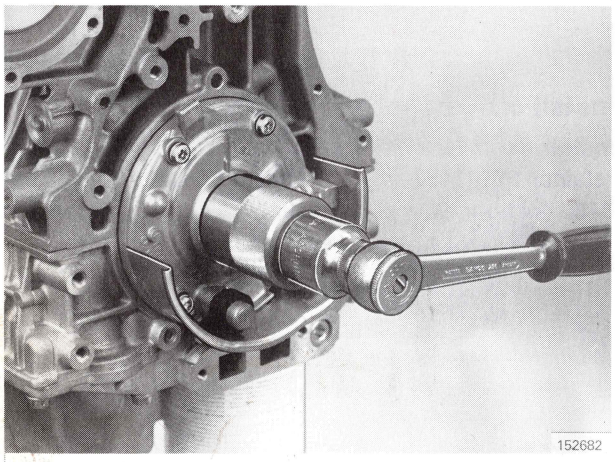
Use drift 999 **5449** and standard shaft 999 **1801.**

Oil seals.

Tap seals home.

L. Timing belt assembly, reassembly

Special tools: 999 5199, -5433, -5450, -5455



L1

Install oil pump

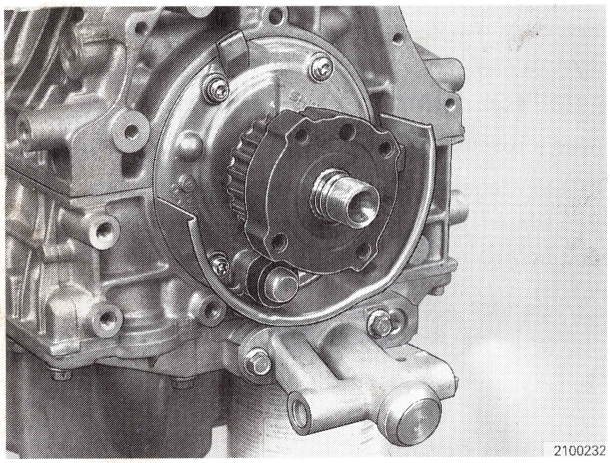
Use **new** gasket.

Use drift 999 **5455** to install pump, using bolts as guides.

Pull in pump using crankshaft center nut.

> **Note:** Do not let crankshaft turn, as this may damage valves.

Use thread locking compound (1 161 056-5) on bolts. Tighten bolts in star pattern to **10 Nm** (7 ftlb**).**



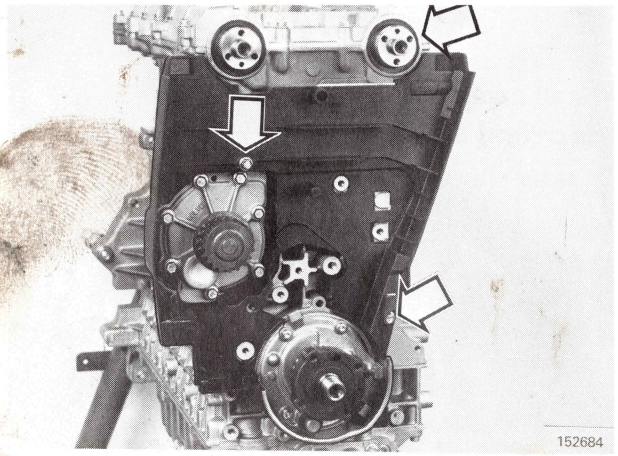
L2

Install belt drive pulley on crankshaft

Install belt drive puilley using center nut and spacer.

Install oil thermostat housing, use **new** O-ring.

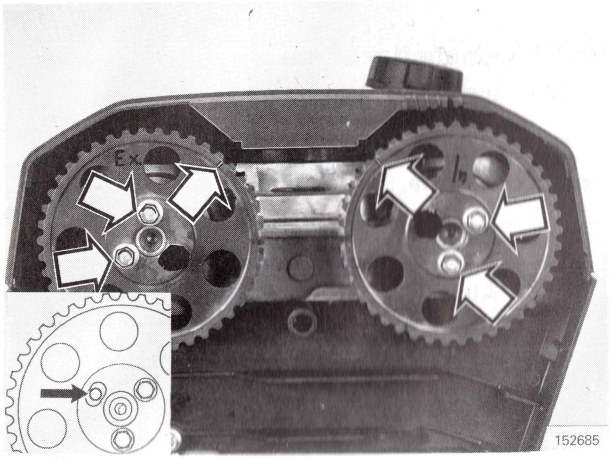
> **Note:** Do not let crankshaft turn, as this may damage valves.



L3

Install:

- inner timing belt cover
- coolant pump, using **new** gasket, tightening bolts alternately to **20 Nm** (15 ftlb).
- thermostat and thermostat housing, using **new** gasket.



L4

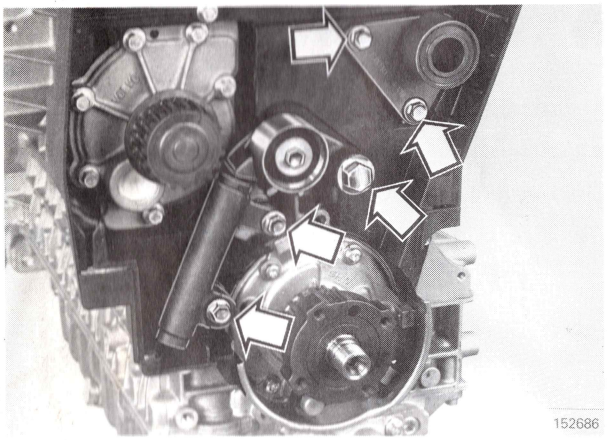
Install upper timing belt cover

Install camshaft pulleys, aligning timing marks as shown.

Insert two bolts in each pulley until they **just touch** the camshaft pulleys.

Remove upper timing belt cover.

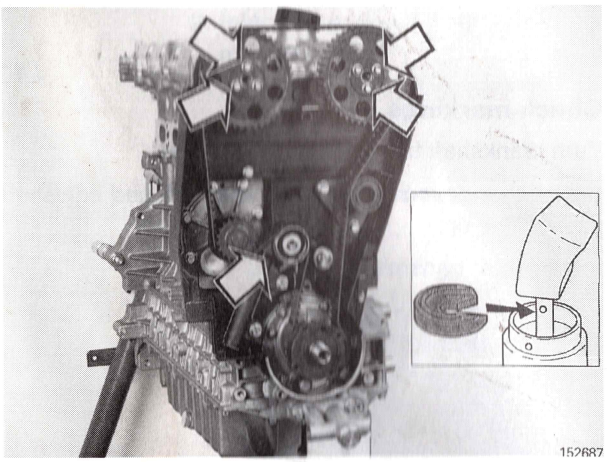
> **Note:** Check that camshaft bolt holes are centered in the oval holes.



L5

Install:

- idler pulley, tighten to **24 Nm**
- tensioner pulley, apply grease to surfaces of the actuator arm bushing, screw and sleeve. Use grease P/N 1161246-2. Tighten screw to: (1991-93) **39 Nm**, (1994-) **30 Nm**.
- tensioner/damper, tighten to **24 Nm**.



L6

Install camshaft belt

Place belt over camshaft pulley, around coolant pump and press the belt over the tensioner pulley.

Undo the two camshaft pulley screws. Pull lock pin out of tensioner/damping unit.

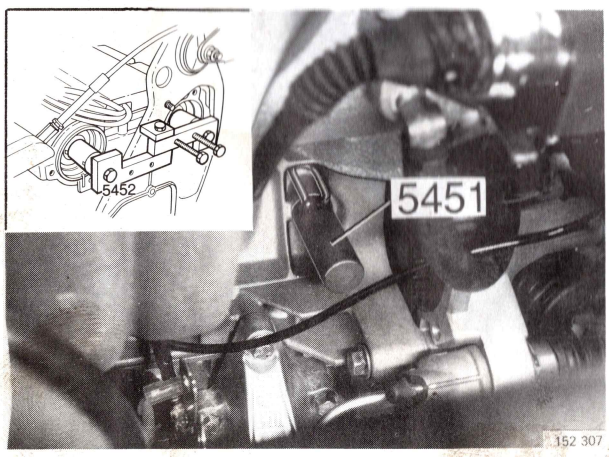
Locate the belt by hitting it gently (twice) with a rubber mallet between the camshaft pulley and coolant pump.

Install the washer to limit the tensioner/damping unit as illustrated. The plastic washer is supplied with the camshaft belt kit (white, P/N 1271851-6).

Install the third camshaft pulley screw and tighten all screws to: ..... **20 Nm** (15 ft.lbs).

Install timing cover.

Install belt cover (snow cover).

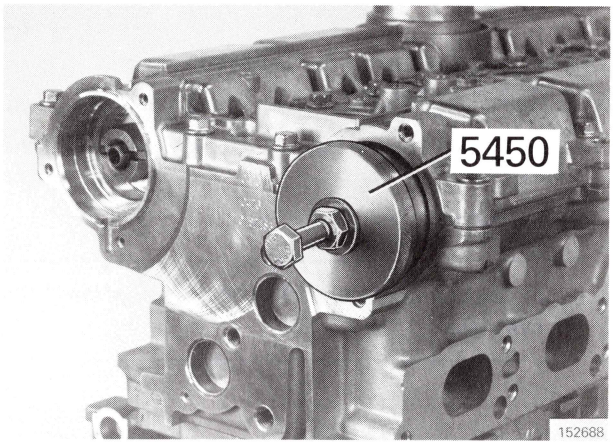


L7

Remove locking tool

Remove crankshaft locking tool (999 5451) and install **new** plug.

Remove camshaft locating tool (999 5452).



L8

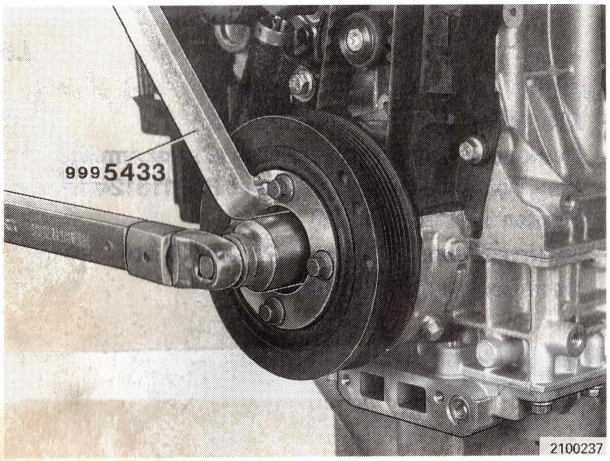
Install camshaft rear seals

Use drift 999 **5450**.

Grease seals.

Press seals home.

> If shaft end shows signs of wear, seal can be pressed another **2 mm** in by turning tool sleeve.



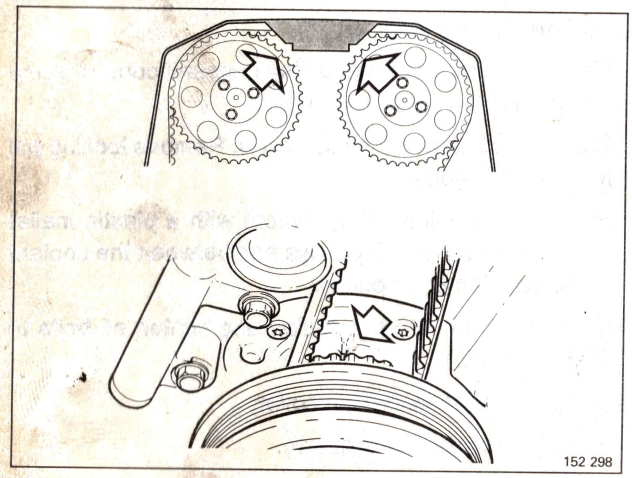
L9

Install vibration damper

Install vibration damper using counterhold **5433.**

Tighten center nut to **300 Nm** (221 ftlb)

Remove counterhold and tighten bolt to **35 Nm** (26 ftlb)plus **60°**.



L10

Check markings

Turn crankshaft through two revolutions.

Check that timing marks on crankshaft and camshaft pulleys line up.

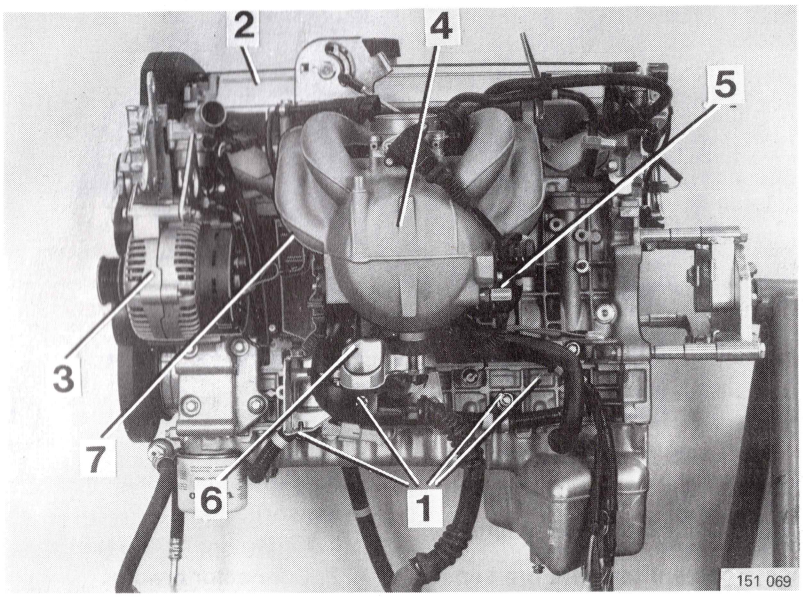
Install outer transmission cover.

M. Cylinder block, refitting components

Special tools: 999 2520, -2810, -5112, -5297, -5428, -5429, -5459, -5464, 5593

M1

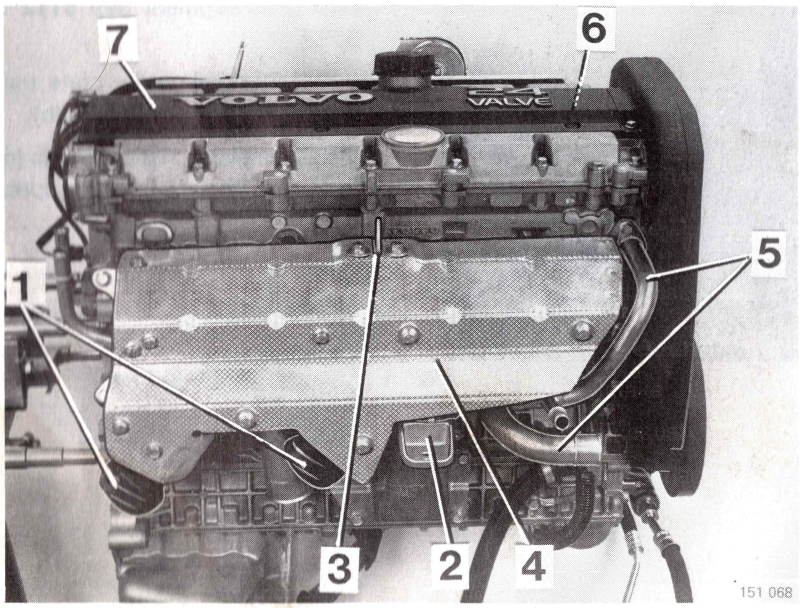
Installation, intake side (B 6244, B 6254, B 6304)



1. Wiring harness
2. Injectors and fuel distribution manifold
3. Auxiliaries mounting bracket
4. Intake manifold
5. Knock sensors (2x)
6. LH engine mounting and bump stop
7. Oil trap and hoses

M2

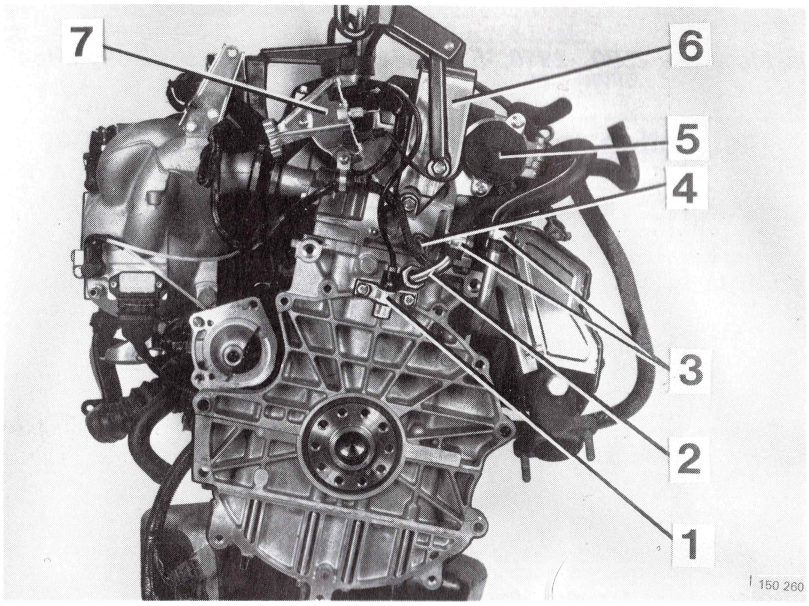
Installation, exhaust side (B 6244, B 6254, B6304)



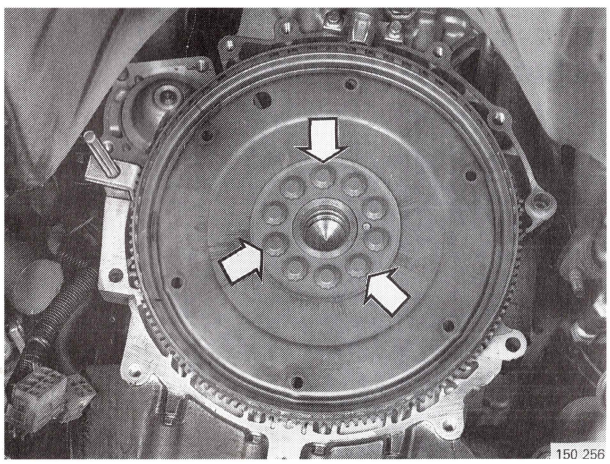
1. Exhaust manifold
2. RH engine mounting
3. Lifting lug
4. Heat shield
5. Coolant pipe
6. Ignition coils
7. Sparkplug cover

M3

Installation, rear of engine (B 6244, B 6254, B 6304)



1. RPM sensor
2. Coolant pipe
3. Coolant hoses
4. Engine coolant temperature sensor
5. Camshaft position sensor (CMP sensor)
6. Lifting lug (999 5429)
7. Connector bracket



M4

Install flywheel/carrier plate

Use gear segment 999 **5112** and special bolts 999 **5593.**

Install flywheel/carrier plate using three special bolts and tighten to **45 Nm** (33 ftlb).

Install remaining standard bolts (new ones) and tighten to 45 Nm. Replace the three special bolts with standard bolts and tighten to: . . . . . **45 Nm** (33 ftlb).

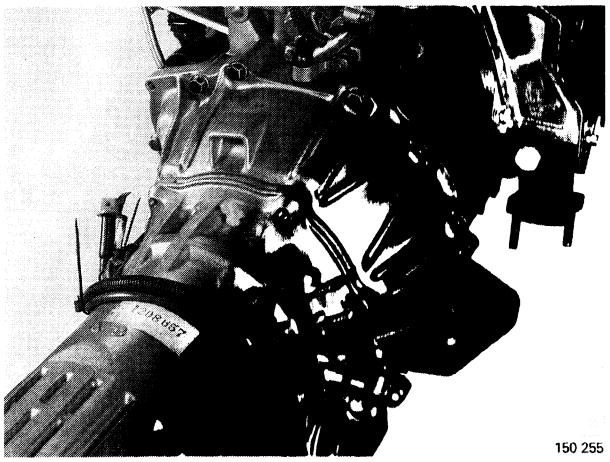
Manual:

Plus: . . . . . .**65°**

Automatic:

Plus: . . . . . .**50°**

M5



150 255

Install gearbox and starter motor

Installing gearbox: See section 4 (43).

Install starter motor.

Automatics:

Install dipstick and tube

Automatic:

Install dipstick and pipe.

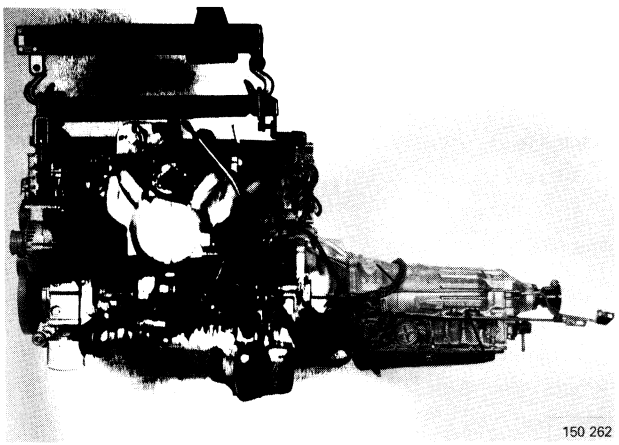
Tighten torque converter to carrier plate, tighten screws alternately to: ..... **30 Nm**

Install transmission, tighten to: ..... **50 Nm**

Manual:

Tighten screws alternately until the pressure plate is pressed home. Tighten clutch driven plate and pressure plate to: ..... **25 Nm**

Install transmission, tighten to: ..... **50 Nm**



150 262

M6

Install engine in car

Install engine as per appropriate steps in service manual: **Section 2 (20-22, 25-26)** (960)

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Comments

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